

The Quest - Team 3

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The Electric Age



Alternating Currents

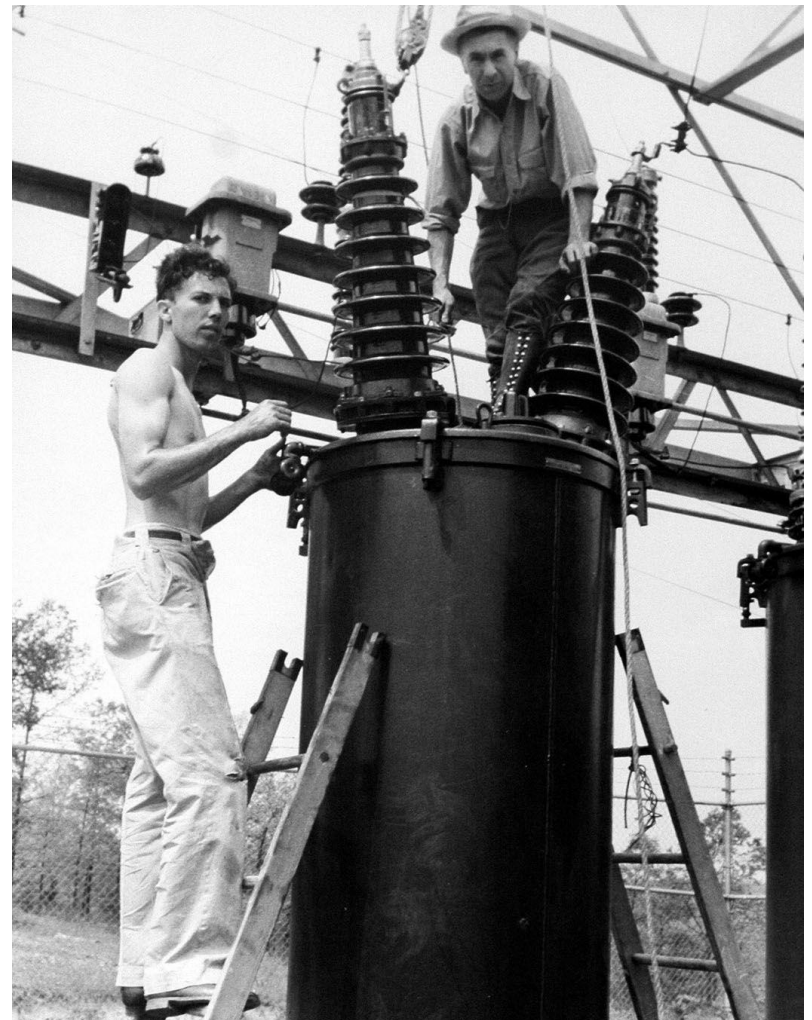


- The Pearl Street Station was the first central generating plant in the U.S which was also a major engineering challenge for Edison and his organization.
- Edison invented the lightbulb to replace the gas-fired lamp. He also worked to introduce an entire system of lighting that could distribute electricity across the city.
- On the afternoon of September 4, 1882, Thomas Edison was in the Wall street offices and at 3:00PM, he turned on a switch and hundreds of light bulbs lit up.
- These light bulbs were used for J.P. Morgan, who was also his lead investor.

Alternating Currents (cont.)

The alternating current (AC) used with a transformer, could help step up electricity to higher voltage, which allowed it to be transported long distances over transmission lines.

<https://youtu.be/UIORO842NWk>



Alternating Currents (cont.)

- Edison would electrocute animals to demonstrate the dangers of electricity
- Edison's company would go on to be named General Electric
- Electricity was priced by consumption using a meter
- By the 1920's, 95% of Chicago homes were wired for electricity
- Samuel Insull worked with Edison to create and integrate electrical infrastructure but eventually fell and became broke



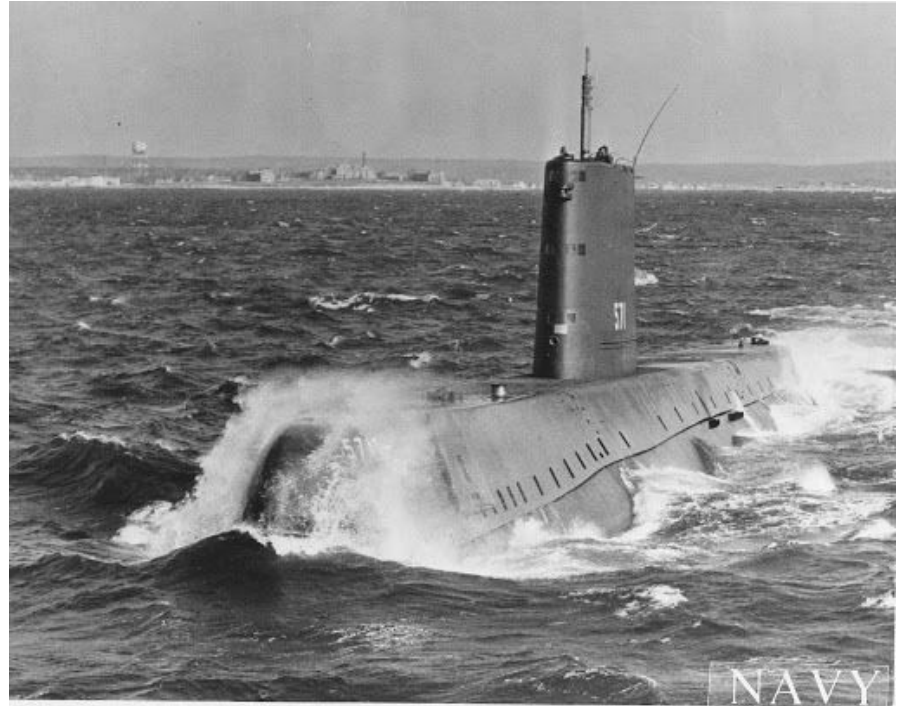


The Nuclear Cycle

- The world was developing more nuclear power and the threat of a nuclear war was growing more intense in the 1950's.
- The dangers of nuclear war is something present Eisenhower had to deal with throughout his presidency.
- “Atoms for Peace” was proposed by the president. This was the idea of using nuclear power for energy and not war.
- <https://youtu.be/e9lidwA4zeU>

The Nuclear Cycle (Cont.)

- Nuclear power offered a solution to submarines in the Navy compared to traditional batteries used. They could travel at full speed for months now.
- The USS Nautilus was the first nuclear submarine commissioned in 1954.
- By 1986, 40% of the navy's major combatant ships would be nuclear propelled.



The Nuclear Cycle (Cont.)



- The first U.S. nuclear plant opened in 1957 in Shippingport, Pennsylvania.
- Nuclear power was projected to provide half of U.S. electricity and was to be “the cheapest” energy source.
- Costs were driven up along with uncertainty about radiation exposure and storage of nuclear waste.
- Nuclear accidents happened around the world from Three Mile Island to Chernobyl. Protests in France and around the world regarding nuclear power took place.
- <https://youtu.be/iiRDwy28-MQ>

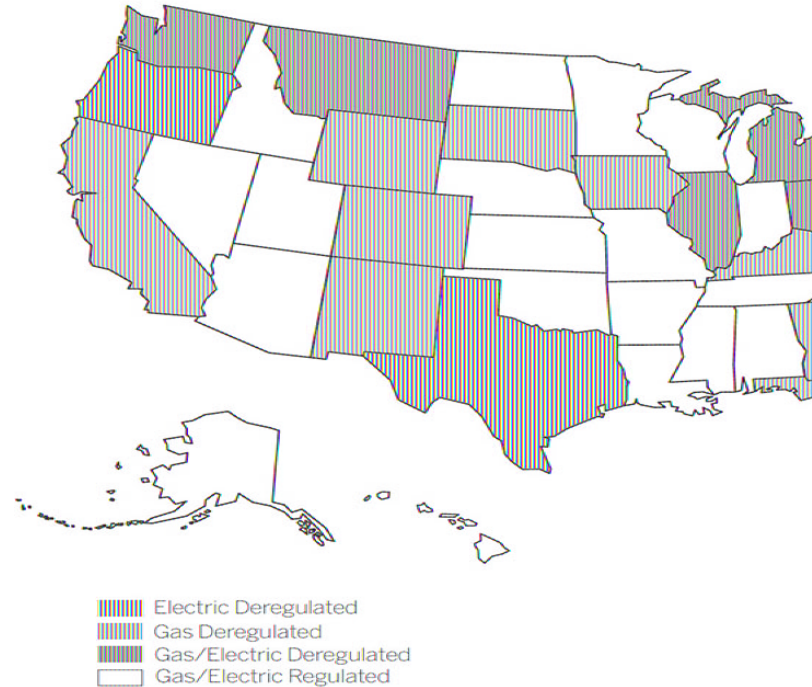


Breaking the Bargain

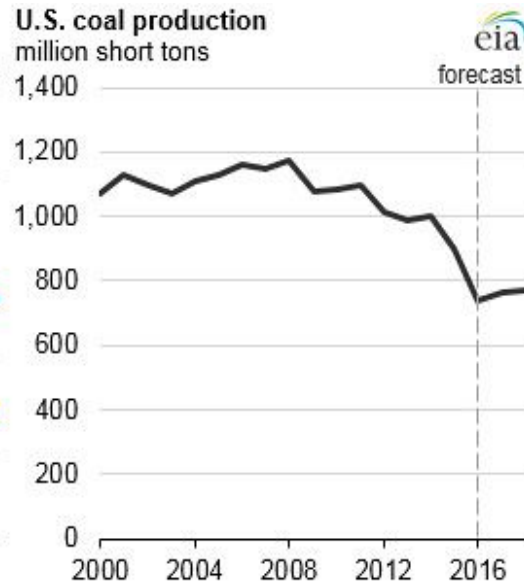
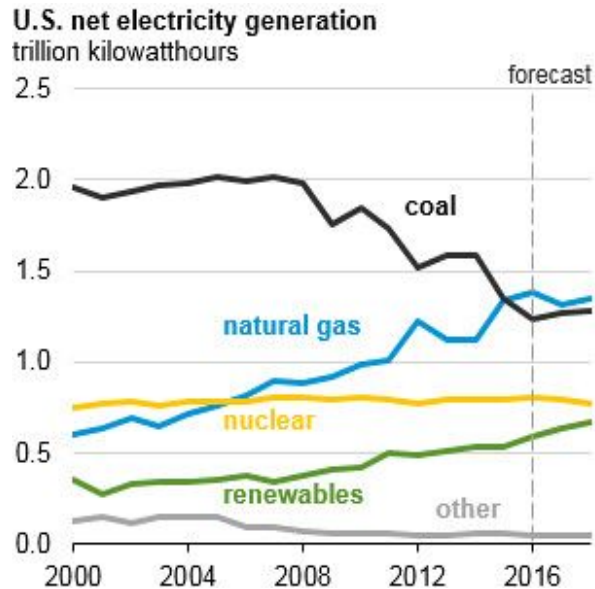
- Electricity prices in the U.S. were declining as there became higher volumes of it in the 70's and 80's.
- Coal and natural gas were domestically abundant
- The United States was moving towards deregulations to allow more competitors in the generation business to sell their power to utilities or end users.
- California went through a power crisis and required restructuring with the goal of adding more competition to lower prices.
- California's economy recovered in the late 90's with real estate sizzling and the internet began to take off. This was due to electricity consumption.

Breaking the Bargain (cont.)

- The drought of 2000 brought issues with power demand surging.
- Utilities accumulated billions of dollars in losses and an energy crisis unfolded in 2001 for California.
- The more electricity was sold, the more money the companies lost.
- Prices rose and consumption decreased which helped to end the crisis in 2003.
- Half of utilities in the country are regulated and half are subject to the free market.
- The major question to today's electric power isn't market design, rather, it is the fuel choice.
- <https://youtu.be/t97AuJ5Bmyw>



The Urgency of Fuel Choice



- Electricity consumption in the U.S. has doubled since 1980 and is expected to double again by 2035.
- Coal use is declining and natural gas is on the rise.
- 40% of the world's electricity is generated from coal.
- Coal produces twice as much CO₂ per unit of electricity as natural gas does.
- Carbon capture and carbon sequestration are possible rising solutions
- <https://youtu.be/kigGiWQw8E8>

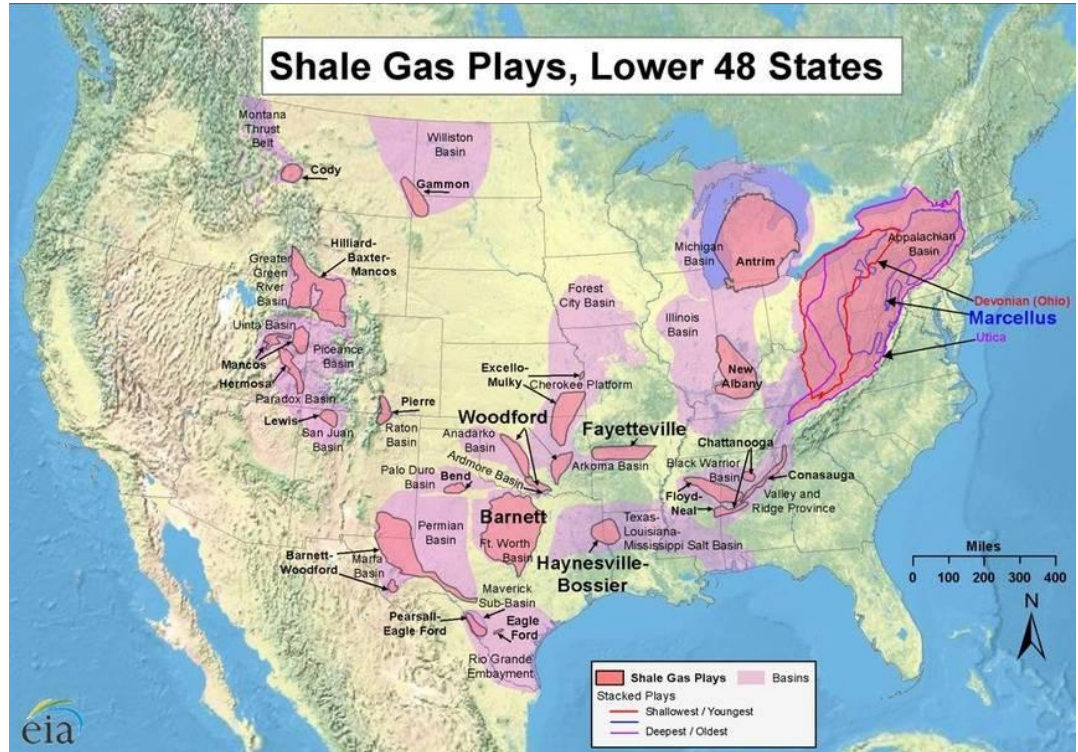
The Urgency of Fuel Choice (Cont.)



- Nuclear makes up 20% of U.S. generation and the Obama administration attempted to restart the nuclear industry in the U.S.
- Storage is one issue of nuclear
- Another issue is countries attempting to make nuclear weapons after they have nuclear power.
- Nuclear is expanding rapidly around the world. This is known as the “nuclear renaissance.”
- France is the world’s largest exporter of nuclear energy.
- Natural disasters can pose threats to nuclear facilities such as the earthquake that caused the explosion at Fukushima Daiichi.
- <https://www.youtube.com/watch?v=YBNFvZ6Vr2U>

The Urgency of Fuel Choice (Cont.)

- The disaster at Fukushima Daiichi caused Germany to back out of nuclear plans and close plants. It raised safety concerns for the rest of the world and ended the nuclear renaissance.
- Natural gas will continue to grow in the future with large deposits and relatively low costs.
- The power industry will continue to struggle with the question of what to build and what to shut down.
- Future fuel choices should be made regarding the climate change agenda.



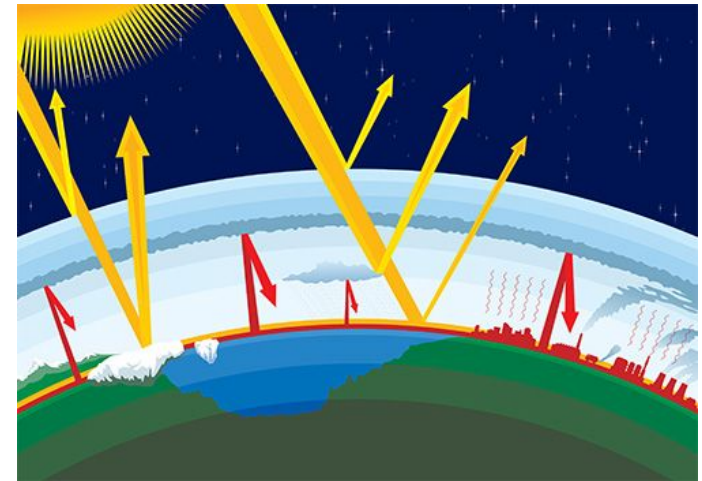


Climate and Carbon

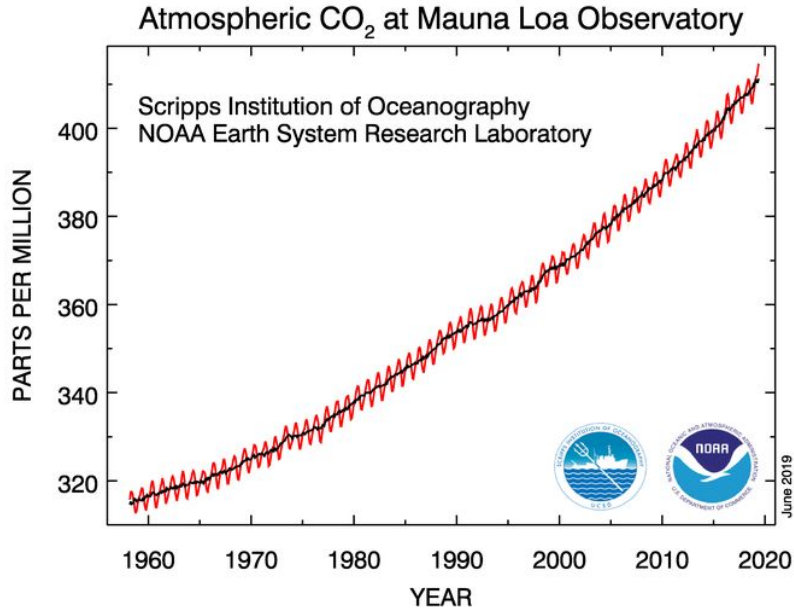


Glacial Change

- John Tyndall discovered that glaciers move
- 98% of the atmosphere is comprised of oxygen and nitrogen
- 80% of the world's energy is provided by the combustion of fossil fuels
- Carbon dioxide and other greenhouse gases act as a balancer to trap radiation from the sun in the atmosphere
- Too much carbon in the atmosphere leads to a warming atmosphere
- Sources of increasing carbon include demand for more energy, deforestation, and land use land change
- <https://www.youtube.com/watch?v=Za5wpCo0Sgg>



Glacial Change (Cont.)



- The atmosphere is similar to that of a lid, retains heat otherwise everything would freeze overnight
- The results of Swedish chemist Arrhenius experiment showed that by cutting the atmospheric carbon in half, the world's temperature would fall by 4 or 5 degrees. Doubling carbon would lead to an increase of 5 or 6 degrees celsius.
- 1938, Amateur meteorologist John Callendar spoke about how carbon in the atmosphere was increasing. No one took it seriously.
- 1951, a climatologist observed that the theory of climate change was never widely accepted and was abandoned.



Glacial Change (Cont. 2)

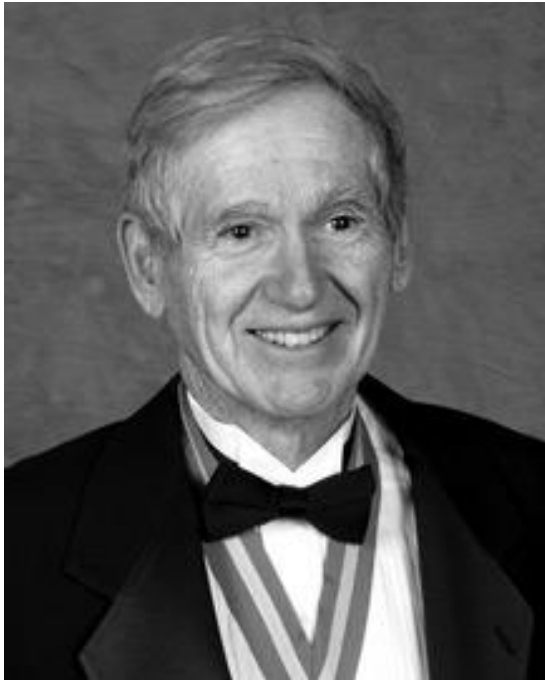
- Early Climatologists were the first to make connections between the rising CO₂ levels and the increase in temperature of the atmosphere
 - John Tindell (early 1950s) - Studied solar infrared radiation and its effect on the gasses in the atmosphere
 - Effectively proved and measured the greenhouse effect of many atmospheric gasses
 - Horace Benedict (late 1700s) - Studied the effect altitude has on various pressure related characteristics like boiling point and vapor pressure
 - Provided a basis for the connection between pressure and temperature
 - Louis Agassiz (1837) - First to propose that the earth had experienced an ice age some time in the past
 - Provided additional evidence to the continuous warming of Earth's atmosphere
 - Svante Arrhenius (late 1800s - early 1900s) - First to use calculate the extent to which increases in CO₂ can increase Earth's surface temperature
 - Confirmed that human CO₂ emissions are sufficient to effect the temperature of the Earth in impactful ways
 - Guy Callendar (late 1800s - early 1900s) - Linked rising CO₂ levels to global increases in temperature
 - Gave rise to a refined theory proposed by Svante called the Callendar effect

The Age of Discovery

- Building off the discoveries of the previous scientists conclusions were drawn in the 1900s using the advances in technology present
- Roger Revelle - Made several correlations between CO₂, the ocean, and Global Warming and is widely regarded as the progenitor of the phrase global warming
 - Discovered the oceans ability to absorb CO₂ abet on a temporary basis
 - Discovered and documented the balance between atmospheric CO₂ sources and sinks and how man made emissions have upset that balance
- <https://www.youtube.com/watch?v=HI3AGkx8nm8>



The Age of Discovery (Cont.)



- Charles David Keeling - Measured and catalogued atmospheric CO₂ levels and speculated its connection to anthropogenic origins
 - Documented the rise in atmospheric CO₂ through a keeling curve
- https://www.youtube.com/watch?v=KD3-5_Y1RA

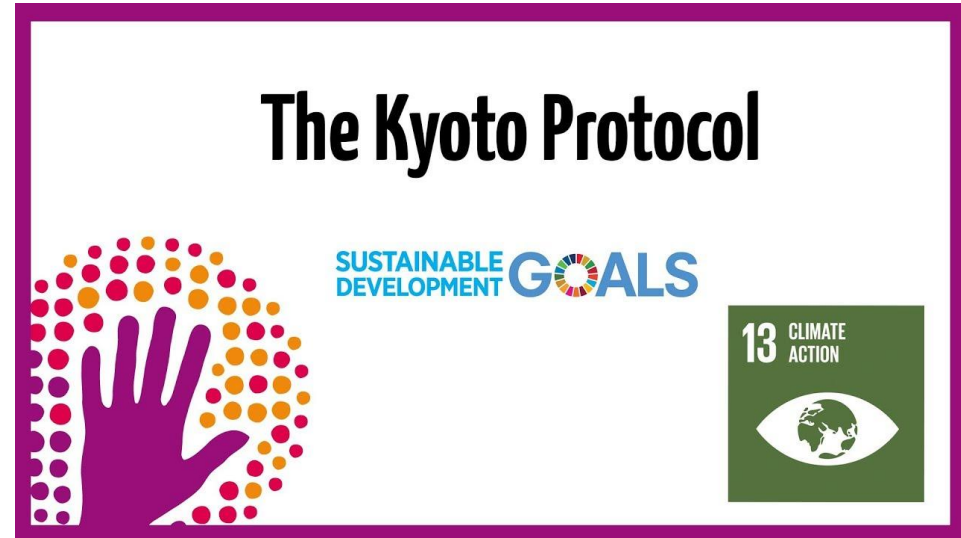
The Road to Rio



- After the discovery of the Ozone hole in the atmosphere and its connection to chlorofluorocarbons the Montreal Protocol of 1987 sought to eliminate the productions of CFCs
- After 1988 the UN called for a conference on limiting the emission of CO₂ and other greenhouse gasses
 - The conference ultimately split the participating nations into those seeking to adhere to these rules and those hesitant on the economic effects of these limitations
 - The conference itself was held in Rio Deshanaro between the 3-14th of June 1992
 - The topic discussed included production of toxic waste, renewable energy sources, greenhouse gas emissions, public transportation, the health concerns related to pollution, and the usage of water

Making a Market

- To kickstart the market for more sustainable resources various economic incentives were put into place to entice investors and entrepreneurs
 - Financially rewards those that can reduce their emissions to certain levels
 - Known as Cap and Trade
- Kyoto protocol - An international treaty that extends the UN 1992 convention on climate change
 - Urges those to the concept that global warming exists and mankind in the likely cause of it
 - Adopted in Kyoto Japan in december 1997
 - Currently consists of 192 parties
- <https://www.youtube.com/watch?v=DFhuNKNDrLg>



On the Global Agenda



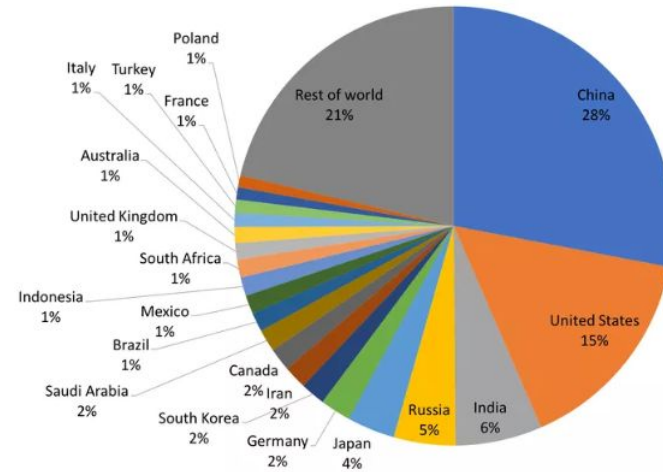
- The 31th G8 summit was held in July of 2005 in Scotland
 - The summit was focused on the issues related to global climate change and the lack of economic development in africa
 - Developing countries were discussed as a medium for the reduction of emissions as effective testing grounds for greener technology through the use of the Kyoto protocol
 - This proposal was not successful due to us opposition and their disbelief in the Kyoto protocol

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In Search of Consensus

- In order for any impactful efforts to be made on global warming a consensus must be reached between the U.S., China, and India
- The obama administration sought to expand on Cap and Trade through further incentives on green technology by treating the reduction of CO2 as an effective currency
- China has responded to this consensus by stating that they too seek to reduce CO2 emissions and per capita are actually lower than the U.S.'s emissions.
- India despite contributing the 5 percent of the world's CO2 emissions is far more susceptible to global warming than any other due to their location and vulnerability to monsoons and rises in sea levels.

Share of global carbon dioxide emissions from fuel combustion (2015)





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