Team 3

Curtis Wilhelm: Part 3
Nate Velazquez: Part 4

Part Three - The Electric Age

- Alternating Currents
- The Nuclear Cycle
- Breaking the Bargain
- The Urgency of Fuel Choice

Alternating Currents

The Wizard of Menlo Park

- Thomas Edison turns on the first lightbulb in 1882
- The Pearl Street Station was the first central generation plant in the USA
  - Required 6 generators
    - Weighed 27 tons each!
- The first electricity bill ever was in 1883
  - $50.44
- Edison had 1,093 inventions patented that he invented in his lab at Menlo Park
- Earned him nicknames such as:
  - America's "Greatest" and "Most useful citizen"
  - "Wizard of Menlo Park"

The Subdivision of Light

- Edison sought after “subdividing light”
  - Deliver electric light to private homes and not just a few street lights
- Costs were a large issue
- To keep his large investor Mr. J.P. Morgan happy he set up 385 light bulbs in his home
  - Issues with this included
    - Loud noises
    - Technician on duty from 3:00 PM - 11:00 PM
    - Electrical fire in library

Battle of the Currents

- DC current could not travel very far
- AC current was the answer
  - Created by George Westinghouse and Nikola Tesla
- Transformers step up DC current to AC current for long travel
- Then step down from AC to DC for subdivision into homes
- This caused a division between Edison and Westinghouse
- Edison tried to battle against AC current calling it unsafe
- Edison had animals electrocuted with AC current
  - Also tried to get the electric chair named “the Westinghouse”
- AC current is too superior and wins battle against DC
- Edison forced to merge with competitor

The Meter Man

- Samuel Insull immigrated to America and becomes Edison’s mentee
- Quickly becomes large part of Edison’s organization
- Insull’s focus was to bring down the cost of electricity
- Insull stumbles upon the discovery of an invention called the electricity meter
    - The meter measures electricity usage
- Insull comes up with the idea to charge electricity by usage and not by bulb
- Insull marketed to utility execs that if their prices were cheap enough it would greatly increase sales

Natural Monopoly: The Regulatory Bargain

- Insull proposed that electricity should be a natural monopoly
- Regulated by the government
- Rates and profits determined by a public utility commission
- This was the only way for costs to be held down

Elektropolis: Technology Transfer Across the Seas

- Electricity makes its way to Germany
- Berlin and Chicago easily had more electricity than London
  - Berlin Population: 3 million
  - Chicago Population: 2 million
  - London Population: 7 million
- London lags behind in electricity
  - Too many generation systems
  - Lack of regulatory framework that would have promoted a more unified system
  - London lags for years after

Aim for the Top

- By 1920 Insull completed his goal of grand scale electricity generation
  - Completed by economies of scale from centralized, mass production to provide inexpensive product
- When Insull took over Chicago Edison in 1882
  - 5,000 customers
  - Paid by bulb
- By 1920
  - 95% of homes in Chicago were wired for electricity
  - Paid by usage
- Insull becomes one of the most famous businessmen in the world and an icon of capitalism

I have Erred: Too Much Debt

- He created a new company in 1928 which went public
  - Stock in 1928: $12
  - Stock in 1929: $150
- The company still needs more capital to expand
  - Insull takes on more and more debt
- Insull's company has shady accounting
  - His companies would overcharge each other
  - Virtually ignored accounting for the depreciation of assets
- Great Depression comes and banks call in their loans from Insull
  - The debt he had taken on far exceeded the value of his stock
- 1932 his whole empire collapses
- Federal government files criminal charges against Insull for fraud and embezzlement
- Insull flees country but is captured in Turkey
- Jury finds Insull not guilty in only five minutes
- Insull dies in 1938 a poor man in Paris

The Nuclear Cycle

Nuclear Cycle

- 1952, Growing risk of nuclear war
- Eisenhower says “there was now enough destructive power to destroy everything
- Eisenhower creates plan “Atoms for Peace” to promote peaceful nuclear power
- All reactor designs contain
  - core - where radioactive material generates chain reaction causing heat
  - Different coolant designs
    - Heavy water
    - Gas
    - Light water
- Admiral Hyman Rickover becomes father of nuclear power

The Nuclear Navy

- Rickover joins secret mission to research how nuclear power can be harnessed for navy
- Rickover finds that nuclear submarines could offer a range that far exceeded diesel fueled subs
- Rickover builds team of highly skilled officers
- Rickover quickly creates the world's first nuclear submarine
- 1954, Soviets create world's first civilian reactor
    - Tiny, supplies only local farms and factories

Too Cheap to Meter

- *New York Times* proclaimed the coming age of nuclear power
- Head of Atomic Energy Commision prophesied that nuclear power would deliver “electrical energy too cheap to meter” in 15 years
- First US nuclear plant in operation in 1957
    - Shippingport Pennsylvania

The Great Nuclear Bandwagon

- 50 nuclear power plants ordered in next few years
- “Great bandwagon market”
- Westinghouse vs. GE
  - Like Edison vs. Westinghouse
  - Westinghouse: pressurized water reactor
  - GE: boiling water reactor
- Projections that nuclear energy could provide half of total US electricity by 21st century
- Turns out nuclear power not as cheap as initially thought
- Costs were:
  - No standardization
  - Projects more difficult and complex
  - Insufficient operating experience
  - Environmental backlash

The Buddha is Smiling: Proliferation

- More concerns growing against nuclear
- Risks of nuclear proliferation
- For years there was confidence only 5 countries had nuclear weapons
  - US, Soviet Union, Britain, France, and China
- May 1974 India explodes peaceful nuclear device
- Proliferation now very real
- Nuclear plants that generate electricity can also produce fuel for nuclear weapons

Three Mile Island

- The core of an operating reactor must be cooled all of the time
- 1979 Three Mile Island experiences catastrophe
- Events start due to shutdown of feedwater pumps that keep reactor cool
- Series of further malfunctions and operator error ensue
- Instrumentation misled the operators, they then turn off emergency cooling system
- These events melt part of reactor core
- Causing a minor release of radioactive steam

The Aftermath

- Rickover writes letter to president on his investigation
  - Accident resulted from minor equipment malfunctions and operator errors
  - Timely recognition and prompt corrections could have prevented accident
  - Similar issues have occured before and did not lead to accidents
  - To reduce probability of repetition, adopt technical standards
- The events at Three Mile Island brought the great nuclear bandwagon to screeching halt

France’s Transformation

- Nuclear development slows down significantly in other countries
- One country that kept going ahead with nuclear was France.
- They did not want to depend on the Middle East for energy
- France’s nuclear program immediately ignited opposition across country
- France continued to build dozens of reactors over the decades

Black Stalks

- Soviet scientists start to warn against the dangers of nuclear
  - Political authorities overruled scientists because it was cheaper to build
- 1986, Soviet operators carry out poorly designed experiment aimed at enhancing safety of the plant
- Through a series of mistakes, they lost control
- Two explosions blew the top off the reactor, followed by a fire
- Reactors did not have the kind of containment vessels that were standard in the West to prevent a catastrophe
- Soviet leadership denied anything serious had happened for two weeks before telling the public

The Exceptions

- Chernobyl's impact
  - Italy shuts down its nuclear power capacity
  - Germany and Sweden aim for a phaseout
  - Britain decommissions their plants
- France was the only one to continue with nuclear
  - Nuclear supplies 80% of France's electric power
  - France is the largest exporter of electricity in the world
- Japan starts nuclear program
  - Japan has no choice but to depend on imports for fossil fuel supply
  - Strengthened safety regulations instead of shutting down

Breaking the Bargain

Rate Shock

- Electricity prices start to decline in US
  - From 1934 - 1970 down 86%
- 70’s and 80’s prices start to go up
- US consumers hit with dramatic increase in monthly bills
- The answer was deregulation
  - Allow consumers to buy cheaper power from someone else than local utility
  - difficult

Toward Market

- Increased confidence in markets stimulates movement toward deregulation
- 1990 British industry was privatized
- Their government broke their generation into three private companies
- The UK’s approach become the global model of how to bring in market competition into electric power

Enter the Merchant Generators

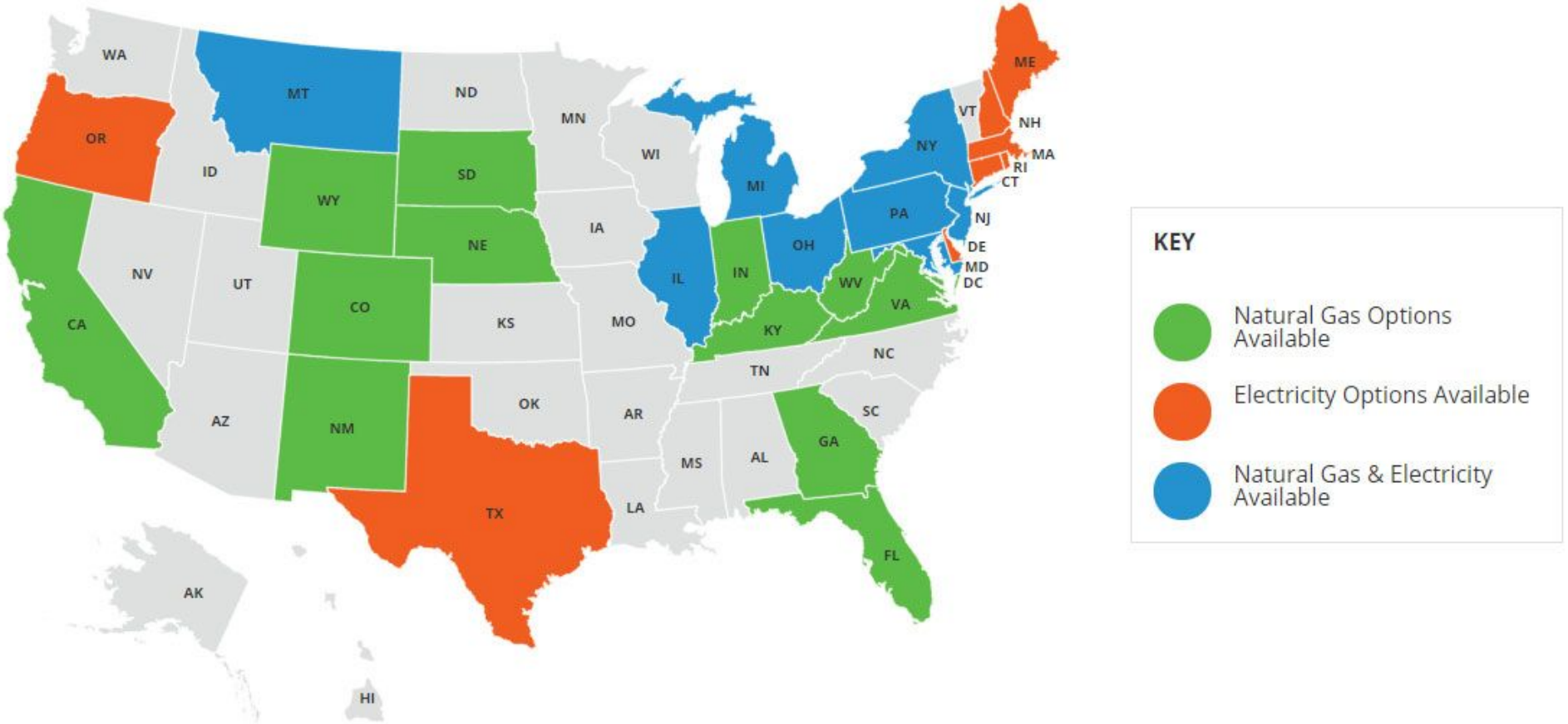
- The biggest challenge was to allow new competitors to get into the generation business and sell their power either to utilities or to end users
- Big idea was to drive down costs through competition
- Federal Energy Policy Act of 1992
  - Allows newcomers to sell electricity into interstate transmission lines
  - “Merchant generators”
    - Did not own wires and distribution system

California’s Power Crisis

- California power crisis in 2000
- Causes
  - Unworkable form of partial deregulation
  - Sharp adverse turn in supply and demand
  - Political culture that wanted the benefits of increased electric power but without the costs
- The state began to experience the first effects of shortages of electricity
- Crisis gets worse as the year progressed
- Power companies asked the state if they could increase rates
  - Denied!
- Governor Davis was dead set against letting retail prices rise

In the Aftermath

- Crisis easing by the summer of 2001
- State authorities finally allow retail prices to rise some
  - Immediately consumers reduce consumption
- Breaks were slammed on the deregulation movement
- About half of states are traditionally regulated while other half have some form of regulation
  - Seen on graphic on next slide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Natural Gas Options Available
Electricity Options Available
Natural Gas & Electricity Available

The Urgency of Fuel Choice

Fuel Choice

- Electricity consumption doubles since 1980
- Expected to double again by 2035
  - USA increase 1.4% per year
- What kind of fuel should we use for this increase in demand?

Making Power

- Options:
  - Coal
    - Declining
    - 36%
  - Natural Gas
    - Increasing
    - 29%
  - Nuclear
    - Steady
    - 21%
  - Hydropower
    - 7%
  - Wind
    - 4%
  - Solar and Oil
    - negligible

- How to make the choice?
  - Depends on
    - Tech
    - Economics
    - Availability
    - Policy
    - Politics
    - Public opinion

Coal and Carbon

- 40 % of world's electricity is generated from coal
- Since 2000, the biggest increase in global energy output has come from coal
- Scientists have cut out 99.9% of particulates, 99% of SO2, and 95% of NOx from coal plants
- Cutting out CO2 emissions is the larger issue
- CO2 sequestering can be done by compressing it to “supercritical phase” then transport by pipeline, than underground storage

Big Carbon

- If 60% of CO_2 is sequestered and injected into storage, it would take up 19 million barrels per day
  - Same as daily US oil consumption
- Estimates project that CO_2 sequestering would increase price of coal electricity by 80-100%
- Other Options?
  - Nuclear ?

Return of Nuclear

- Nuclear is the only large scale source of electric generation currently available that is carbon free
- Nuclear holds 20% electricity generation as it did in the 80's
  - How??
- Plants operated at 55% of generating capacity in 80's
  - VS. >90% today
- Nuclear Regulatory commision grants license extension to half of nuclear plants
  - Without these extensions almost all plants would have shut down

“We are going to restart”

- Obama gives federal loan guarantees and tax incentives to build two new nuclear plants
  - First in many decades
- “We are going to restart the nuclear industry in this country”
- This was the catalyst for the proposal of 30 new reactors

Deep geologic storage

- Nuclear waste only a fraction of the amount of carbon waste that would be injected into the ground
  - Nuclear: All nuclear waste could fit into a football field to the height of ten yards
  - Carbon: one coal plant would require 600 football fields of liquid waste in one year
- People living near nuclear storage would receive no more than 15 millirem of radiation a year for next 10,000 years
  - Equal to the amount of radiation you receive from 3 round trip flights from New York to LA

Fukushima Daiichi

- Earthquake and tsunami off the coast of Japan on March 11, 2011
- Complex little damaged by earthquake
- Tsunami flooded the station
- Causing failure to keep cooling pumps working
- Overheated and blew up causing fires, spread of radiation, and meltdown of the core
- Highest rated accident level
  - Level 7
  - Same as Chernobyl
- 9 month clean up
- A year later all of Japan's 54 nuclear plants shut down
- 50% of Japan electricity was completely abandoned
- Germany shortly shuts down all of their nuclear plants

Glacial Change (p423);
“The Sentiment Of Wonder”

John Tyndall- originally a British surveyor not able to get a regular scientific education from hope spent his life savings to go study under the chemist Robert Bunsen (Bunsen Burner)

He became almost obsessed with the study and mapping of glaciers in Switzerland

Later he was welcome into the Royal Institution, among his many accomplishments he answered why the sky is blue

He was almost the first person to summit the Matterhorn, but failed to because his guilds wouldn’t allow him to travel the remaining few hundred feet

He was the first scientist to realize that glaciers aren’t frozen in time but that they actually moved; he was the first to study how glaciers moved and migrated.

Through his work he theorized how the atmosphere worked and how those glaciers formed whether it be from an ice age, and if so when did it stop and why and then also if it would return.

The New Energy Question

In general energy related issues are or frequent questions are related to price, security, availability, and pollution.

Today when we make energy policies we have to take into account how it will effect climate change and global warming. This is where many energy policies seek to reduce greenhouse gas emissions from coal, oil and natural gas as well as other combustibles that we burn for our energy

“Today more than 80% of American energy… is supplied by combustion of fossil fuels”
“The modern world we know rests on our hydrocarbon foundation”

The Rise Of Carbon

CO_2, Methane, Nitrous Oxide and other green house gases allow the Suns shortwave radiation to pass through the atmosphere to warm the planet but then when those short waves are transformed into long wave infrared radiation after hitting the earth those same green house gasses an stop the waves from escaping into outer space, keeping our planet from being a frozen wasteland

These green house gases keep the balance, making sure the earth isn't too hot to where we'd all boil and not too cold to where it would be winter year round

This balance is what is at the heart of climate change science

Majority of the carbon in the atmosphere is there via natural processes but humans have added a significant portion of gas since the industrial revolution and its only growing

Other Major sources of emissions- giant forest fires (deforestation), Poverty stricken people will burn anything for fuel creating black soot, animals release methane and nitrous oxide, rice cultivation is generates methane, Yet CO_2 is the most significant green house gas volumetrically speaking

Scientists of yesteryear said that CO_2 was an experiment with the atmosphere but scientists today warn of how we are playing with altering, possibly irreversibly, our climate in potentially apocalyptic ways- Melting ice caps, transforming fertile land into deserts, generating natural storms with more devastating effects,

Scientists in the minority say that CO_2 is not directly related to climate and say that most CO_2 is natural and that we shouldn't be concerned p428

Why Not Too Hot Or Too Cold

Glaciers let us see into the past while being in the present, allowing us to ask questions about our past and speculate about our future

“What could have made the climate change? And could the glaciers return, like some fearsome primordial beasts, crushing everything in their paths, smashing and obliterating human civilization as they advanced?”
this brings us to the swiss alps about 100 years before John Tyndall ever was there

The Alpine ‘Hot Box’

Horace benedict de Saussure was a scientist/professor at the university of Geneva created the word geology as well as making it a personal mission to understand the natural world in Switzerland’s high peaks

Saussure was fascinated with heat and altitude and build equipment to measure temperatures on mountaintops and the bottom of lakes

He built a greenhouse in the alps to try and understand why the heat of earth wouldn’t float into space, and realized that the earths atmosphere was similar to the glass roof of the green house, allowing heat and light in but only letting some of each escape trapping the rest in the greenhouse and thus keeping the earth warm even when the sun had disappeared
Joseph Fourier-decorated mathematician- admired Saussure’s work and devoted much of his own research into heat flows was convinced Saussure was correct

In the 1820’s Fourier set out to do the mathematics to prove the relationship between the atmosphere and temperature on earth but after many tries said there is “no regular mathematical theory” to explain it, leaving it for other people to work out
Over decades people have come up with the metaphor “greenhouse effect“ describing how the atmosphere traps in heat

The atmosphere: ‘as a dam built across a river

John Tyndall built the spectrophotometer which could measure whether gasses could trap heat and light or not. He experimented with O2 and N2 but since they were transparent they couldn’t trap light or heat, then he tested Methane, opaque in infrared light it darkened. This was his proof, it trapped infrared light, he also tested water vapor and CO2 each had similar effects thus meaning they too could trap heat
He had the first public and experimentally based account of the greenhouse effect.

After a life of marvel, traveling and working in the most dangerous and inhospitable places nearly escaping death, he died in 1893, mistakenly poisoned by his wife who was administering sleeping medicine to relieve his intolerable insomnia. His dying words were,” My poor darling, you have killed your John.”

Arrhenius: the great benefit of a warming climate

1894 a Swiss chemist Svante Arrhenius was curious about how increasing and decreasing levels of CO2 in the atmosphere could have an effect on the climate this is what he called “geological climatology”

Arrhenius lost both his wife and son via divorce, because of this he threw himself into his work, working 14 hour days sometimes, trying to calculate the effects of changes in carbons by hand.

From his work he theorized that if ½ of the atmosphere's carbon were to be removed it would lower the world's temperature by about 4 or 5 degrees centigrade additionally, doubling the carbon dioxide would raise the temperature 5-6 degrees centigrade all done by hand without the help of a supercomputer his range was in line with the contemporary models.

Arrhenius thought it would take 3000 years for CO2 to double in the atmosphere and he thought that it might even be a good thing for the CO2 to double, he joked increasing C02 would not only prevent another ice age, but it would actively allow mankind to ‘enjoy ages with a more equable and better climate’ making farming in cold regions possible even in previously unimaginable areas

His grandson Gustaf Arrhenius said that scientists at the time were just disappointed it would take so long because they wanted milder climates in northern regions and thought increased CO2 would yield higher crops

The Effect of Guy Callendar

1938 Guy Stewart Callendar collected more data than anyone on weather patterns and CO2 levels

he found that not only was CO2 increasing in the atmosphere but that it would lead to a change in climate, more specifically global warming “the return of the deadly glaciers should be delayed indefinitely

While he was an amateur many people in attendance at the royal meteorological society didn’t take him seriously because he was a steam engineer
YET the effect he described the role of CO2 in the atmosphere would later be known as the Callendar Effect

1951 prominent climatologist observed that the CO2 theory of climate change “was never widely accepted and was abandoned”

The Age Of Discovery (p436);

Roger Revelle 1990 National Science Medal for “work in carbon dioxide and climate modification” as well as “oceanographic exploration presaging plate tectonics, the biological effects of radiation in the marine environment, and, studies of human population growth and food supply”

His great scientific expedition would unfold over decades, from ocean bottoms to mountain tops from glaciers to even outer space is what put climate change and heretofore unknown subject of global warming firmly on the political map.

Revelle said during his acceptance speech “I got this for being the grandfather of the greenhouse effect”

During WW2 he was the U.S. Navy’s chief oceanographer, helped create the Office of Naval Research funding almost anything that could be considered serving national defense he also helped the ONR to create the National Science Foundation

Took Scripps Institution of Oceanography north of San Diego, turning it from a one-boat outpost into a “top carbon cycle research center in the U.S.”

Revelle organized expeditions after WW2 that sailed for months into the then-unknown waters of the mid and

Large scale Geophysical Experiment

Revelle had given a lot of though to Guy Callendar's theory of CO2 in the atmosphere heating the climate, but thought he was wrong because of his own research. But by the mid 1950's Revelle was beginning to change his mind because of his involvement with nuclear weapon tests in the pacific.

Finding sharp or sudden temperature variations in water temperatures at different depths, they thought of the ocean to be a deck of cards meaning the mixing between levels was limited,

Releasing a paper with college Hans Suess "Carbon dioxide exchange between atmosphere and ocean and the question of an increase in atmospheric CO2 during the past decades" stood by Revelle's previous work in stating that CO2 could be absorbed by the oceans but it would later rejoin the carbon cycle, so on a net basis the ocean absorbed much less CO2 than expected, meaning that CO2 would inevitably end up in the atmosphere. A last minute addition to his paper was that "the buildup of CO2 'may become significant during future decades if industrial fuel consumption continues to grow exponentially… Human being are now carrying out a large scale geophysical experiment of a kind that could not have happened in the past nor be reproduced in the future."

Even a decade later he said that our attitude towards rising co2 levels in the atmosphere brought about by our own actions should probably contain more curiosity than apprehension.

The unexpected impact of the international geophysical year

The IGY was several thousand scientists from more than 70 countries determined to learn all of Earth’s processes from core to seabed floor this gave us great knowledge about how deep water currents flow

Okay, Lets go; the strategic importance of weather

Russians say General Winter defeated the Nazi's as they tried to advance though the Russian winter

As well as in D Day invasions, where weather played a huge part because hours leading up the greatest sea to land invasion ever, the only factor that was on the go/no go decision matrix was the weather

At the time Eisenhower said "weather in this country is practically unpredictable" and it almost was, largest reliable forecast was only 2 days and if the seas were rough then it was only reliable for 12 hours
Allied meteorologists saw a break in the weather that nazi's didn't and because of this, the allies were gearing up to head over the channel just as the nazi general had told his soldiers they could rest easy because the weather wasn't letting up

The IGY following Eisenhower's direction was designed to deepen the knowledge about climate and weather science. One of their scientists had a theory that the world would experience a warm period because of carbon dioxide being pumped into the atmosphere at several billion tons a year

The Meeting at woods hole

Roger Revelle headed the oceanography panel for the IGY, with his help, Gustav Arrhenius and others they decided to try and calculate the impact of CO2 on the atmosphere. But to do this they had to have a way of measuring CO2

Charles David Keeling didn't want to study economics he dropped out of a chemistry undergrad program because it had an econ requirement and finished with a degree in liberal arts while still getting into a PhD program in chemistry at Northwestern, while in the program he came upon a book "glacial geology and the Pleistocene epoch" and it had a lasting effect on him "I imagined climbing mountains and measuring physical properties of glaciers" Keeling much like Tyndall found a love for glaciers

Keeling was able to combine his love of chemistry and geology in the geochemistry department at the California institute of technology. He found a love for CO2, keeling found himself on top of university building measuring the air for levels of CO2, but because of local pollution it made levels erratic. Keeling traveled up and down California to find good spots to test CO2 but without funding ran into a wall

That's when Revelle offered him a job a Scripps, along with research money, he did so because he saw how much he wanted to measure CO2 in every way imaginable, and wanted him on his team even if that was the only thing he wanted to do

Global Cooling: the next ice age

Lyndon Johnsons scientific advisory board had a 22 page appendix detailing the possible risks of using fossil fuels
Daniel Patrick Moynihan, said that if CO2 in the atmosphere would cause the temperature globally would mean no more NY and no more Washington but said he had no data on Seattle
Deputy director of the office of science and technology wrote back to Moynihan saying people either think we're going to have to grow gills to survive this rising sea level or that we will have another ice age and everything inbetween.
Many people were unsure of what would happen with the climate whether it would cool or warm, in 1970 the CIA ran simulations of what global cooling could mean for Americans and the ramifications of it globally
People who had worked on the defense departments climate analysis program asked Nixon for money to study the risk of a new glacial period while others warned that the increased amount of aerosols in the atmosphere could already trigger an ice age

The magazine National Geographic gave weight to both the earth was either cooling or heating but that it was irreversible

The possibility of Nuclear winter in the 80's made because of cloud cover stopping sunlight from entering the atmosphere almost became a reality while the US and Russia ensured mutual destruction for each other along with the rest of the world if they were to unleash both their arsenals.

Modeling the Climate

we could now use satellites to further understand climate and under JFK Weather modification became a topic of discussion at the UN

The advent of the computer allowed models of the climate to be constructed so then it could be further understood John Von Neumann, Herman Goldfine

John Von Neumann came to the US along with Albert Einstein in 1930 to work at Princeton institute for advanced study, he was known for having one of the fastest minds figuring out complex mathematical problems in his head with ease,

John Von Neumann also, in his dying moments, was surrounded by the secretary of defense and his deputies, the secretaries of the army navy and air force, and the joint chief of staff all there for his last words of advice and wisdom

He built a computer at Princeton and applied its power to solving nuclear bomb models and weather models which were nonlinear problems in fluid dynamics that needed the processing power

John Von Neumann supervised the MANIAC building – Mathematical analyzer, numerical integrator and computer

Boy if this is true; the rise of climate activism

Fred Krupp- Yale 1973- Krupp becomes president of the environmental defense fund at 30

Rafe Pomerance- President of friends of the earth was reading an environmental study stating increasing coal use could warm the earth, he confirmed with Gordon MacDonald a member of Richard Nixon's environmental staff, they then toured DC doing briefings where they ran into the president of the national academy of sciences, who setup a special task force under Jule Charney to further investigate this

Charles Keeling, Roger Revelle, George Woodwell and Gordan Macdonald all said that immediate action should be taken to address climate change before it is too late, they came up with a four point program, 1) acknowledgement of the problem
2) Energy Conservation 3) Reforestation 4) lower carbon fuels
they presented this plan to Gus Speth, the chairman of the US council on environmental quality

1980 Reagan is elected, Russians in Antarctica as well as scientists in Greenland recovered thousands of years old ice fragments which contain 275 p/billion co2

Revelle’s exile

Revelle was denied chancellor at University of California San Diego but decided to become a professor at Harvard instead, explaining that there probably hadn’t been this much carbon in the atmosphere for over a billion years since it had been trapped in the earth

Al Gore studied under Robert Revelle at Harvard and sparked his interest in climate issues, Gore said, “Like all great teachers, he influenced the rest of my life.”

Al Gore and 7 other senators are “deeply disturbed” by CO2’s involvement with climate change and want to see some action taken 1986

The Road To Rio (p457);

June 23rd1988, over 100 degrees and humid, Tim Wirth Senator from Colorado was the first ever bring global warming into the hearing room.

It is said the night before the air conditioning was turned off and all of the windows to ensure the building would be sweltering

Many decorated witnesses spoke before congress that day, after Wirth opening with “the Scientific evidence is compelling, now the congress must begin to consider how we are going to slow or halt that trend.”

James Hansen- atmospheric physicist and director of NASA’s Goddard Institute for space studies in New York City said, “We can ascribe with a high degree of confidence a cause and effect relationship between the greenhouse effect and observed warming”

the hole in the ozone: the role model

Chlorofluorocarbons (CFC's) are found to be ten thousand times more potent in trapping heat than CO2

In 1985 researchers with British Antarctic survey realize that these CFC's are tearing a hole in the planets atmosphere, destroying ozone,

Montreal Protocol was the first multinational pact to protect the atmosphere from greenhouse gases

James Henson’s ‘Venus Syndrome

Henson Vs the world

After James Henson talked in congress Tim Wirth wrote to Robert Revelle to get involved on the climate discussions going on globally and revelle said that we had better wait 10-20 years before saying that the green house effect is what is causing our rising temperatures. He added that if it is then we better pursue nuclear power, reforestation,

Both Henson and Revelle got involved in the climate crisis two very different ways, Revelle was an oceanographer and saw the implications of adding carbon into the carbon cycle, Henson learned of CO2 via his knowledge of outer space and his understanding of the greenhouse effect on Venus, which he had studied while pursuing his PhD

Henson, who studied the CO2 atmosphere on Venus (surface 900 degrees F) and its runaway greenhouse effect would coin the term “Venus syndrome” to describe a runaway greenhouse effect.

The hot summer of 1988 and white house effect

George H.W. Bush was the first president hopeful to mention climate change as a core issue, “to those who think we are powerless to do anything about the greenhouse effect are forgetting about the white house effect … I intend to do something about it.”

Reporters call out Henson for being wrong since the summer placed 11 on hottest years recorded, UN general assembly one delegate said that it “seemed like science fiction to many people “

Mrs Thatcher

Margaret Thatcher was one of the first women to come onto the climate change scene, at the time she was Britain's prime minister and a chemist before entering office

Changed electricity generation from coal to natural gas after union brought country black outs

Margaret Thatcher "for Generations we have assumed that the efforts of mankind would leave the fundamental equilibrium of the worlds systems and atmosphere stable, but it is possible with these enormous changes in population agriculture and use of fossil fuels concentrated into such a short period of time , we have unwittingly begun a massive experiment with the systems of this planet itself."

The IPCC and the ‘Indispensable Man’

The intergovernmental panel on climate change and their coordinator in chief Bert Bolin at heart at mathematician starting in 1950 he worked at Princeton with John Von Neumann and Jule Charney helping write equations for those first computerized weather predictions.

Bert Bolin later returned to Sweden and switched to geochemistry and became and expert on carbon dioxide and the carbon cycle, bolin believed we should have the research to back up and support legislative action after we know what is known

James baker presented to congress a bill to do something proactive about climate change even if we didn’t know the worst would come, and while bolin was happy to hear bakers speech thought that it was “premature to rush into an action program”

Shoot-out at Sundsvall

After a week of delegations and no end in sight in time to present to the UN general assembly, the UN appointed translators had reached the end of their work day and decided to go home leaving no end in site for the their pitch. But just then one of the French chairman who had insisted on speaking French all week, decided to speak English this allowed talks to continue to the point of where a signing was about to happen but a Russian scientist who hadn't been active after the translators had left wasn't going to sign the deal so it wouldn't pass and go to the UN. This is when an American scientist who was fluent in Russian talked to him, and found out the only reason he wouldn't sign was because he couldn't understand what was in the document because of the language gap and didn't want to sign anything he didn't understand thankfully with the help of this new translator he was onboard with the presentation to the UN.

In October 1990 the IPCC delivered their first assignment to the UN General Assembly but they said the findings where to close to climate models and natural climate variability.

Bolin-"by the time that question was clarified, the commitment to future climate change will be considerably larger than today" and it would be harder to deal with

Getting Ready for Rio

known as the United Nations Conference on Environment and development was to be held in rio

what happened?: small developing nations didn't want to constrict their economic growth by submitting to cut emissions while first world countries wanted a time table for CO2 targets over time so gradually reduce emissions

to go or not to go

White house chief of staff under George HW bush thinks climate change believers are anti growth and anti development
William Reilly the administrator to the EPA told Bush he must go while John Sununu white house chief of staff tried to stop him from attending

European communities environmental commissioner publicly denounced bush for his “hostility” to specific targets and timetables on emissions. The Germans argued that the United States needed to “accept the stabilization commitment”

A Major Harangue Down There

Bush decides to go to the conference in Rio after being criticized by bill Clinton, after losing touch with his base, after coordinating so well with allies in war he didn’t wanna let them down and after John Sununu left his administration

the diplomatic free for all

Described as just that, a free for all, where Fidel Castro and 160 other world leaders came to meet and discuss climate change. While George Bush was perceived as Darth Vador by the new york times, his signing of the treaty made the US the first of industrialized nations to ratify the new agreement of steadying emissions

What the framework convention set in motion

as part of the agreement industrialized countries took on commitments to control their emissions but and the non-industrialized countries didn’t have any obligation other than to measure data levels

Making a Market (p475)

Would it be a good idea to use our market economies to try and sell our pollution?
Would it be moral?
Cap and Trade

The Scribbler in chief

Ronald Coase, 1991 at the age of 81 won the nobel prize in economics for two articles, in one “the nature of the firm” the question, why do people coalesce into companies in a market economy rather than remain free lancers in a sea of self employment the answer is traction costs, it is cheaper and more productive to do things with a company. The second is “the problem of social costs” he showed that it was better to trust in the market rather than let your gov control and subsidize everything.

The War on pollution

in 1970 Richard Nixon started the Environmental protection agency, EPA, with a soul goal of fighting pollution “war on pollution” as Nixon put it

As well as clean water and clean air acts

Old enough to remember

early 1980's they made the decision to take lead out of gasoline because of its toxicity and 'knocking' was still huge problem breaking engines within 5 years after using the market to make it easier on everyone lead was fazed out of gasoline refineries could get permits to un-lead gasoline while it was processed from petroleum

Project 88- identified a host of environmental and energy problems, John Heinz (R) and Tim Wirth (D) founded this and drafted Harvard business professor to solve the problems of the country that problem solver was Robert Stavins-"they hired and economist and so they got economic ideas" Harnessing market forces, climate change, delivering quicker and better results

the acid test of acid rain

Acid rain from the SO2 that can be given off by coal power plants was a huge problem during Ronald Reagan's presidency, he left and there was 70 different acid rain bills introduced in congress but none of them passed making Canada jokingly say theyd declare war on us if we didn’t stop. In Europe it damaged almost half of the trees in Germany’s black forest

Both Michael Dukakis and George HW Bush had a pledged to reduce SO2
Shortly after bush’s victory he invited Robert Stavins to come up with a market based solution to acid rain. Boyden gray was interested in applying market principles to environmental questions to reduce compliance costs

Least-Cost solutions

Originally congress was upset because it was Appalachia(high sulfur content and unionized) verse the Midwest(low sulfur content and non-union) coal supplies

Boyden Gray got a team of economists and industry professionals on market incentives to brain storm a way to bring the acid rain trend to a halt. They didn't want to tell people how to process their coal but they also didn't want have a completely how to do the process so they created standards for which these plants operate at but encouraged every plant to run how they choose but insisted it be the best and least cost outcome

The Grand Policy Experiment

November 15th1990 George HW Bush signed the clean air amendment into law, allowing the trade of emissions while stil reducing the total number of permits year by year would have the effect of making permits scarcer and thus more expensive thus giving incentive to reduce emissions.
Emissions trading allowed much larger reductions at much lower price and was much more speedy than it would have been with a regulatory system
Allowance trading became cap and trade

the discernible human influence on climate

IPCC report 1995-“the balance of evidence suggests that there is a discernible human influence on global climate”
Bert Bolin oversees project

developed Vs developing countries

developing countries didn’t want to be constricted by having a carbon limit because 75% of all greenhouse emissions from 1860-1990 we from industrialized nations, but those nations only had 20% of the world's population

China felt it had been dealt a bad hand, and Angela Merkel was the chairman for the IPCC in berlin in 1995, she was a physical chemist before the Berlin Wall fell, at this berlin mandate meeting, industrialized countries set goals for lowering emissions while non industrialized countries would be spared and didn’t need to have a plan to scale down greenhouse gas emissions

Battles at Kyoto

1997 Stuart Eizenstat, undersecretary of state for economic, business, and agricultural affairs, new to the US delegation came to the massive conference

Later it was found out the Japanese cut heat to the conference center then instead distributed blankets but didn't have enough for everyone making a whole new argument

Europe vs the united states

because of Margaret thatcher winning the election in Britain, coal was being phased out and replaced by gas, today the US Europe and Japan all have agreed to 6-8% drop in lower by 2008-2012

Developing Vs developed countries

‘Clean development mechanism ‘-undeveloped nations could invest in developed nations energy

Cost cost and Cost

Eizenstat put it, “there were three isssues, cost, cost, and cost.” Without a market system in place the costs would be to great to regulate the energy industry. This conference too just like the first one in Rio was ended in an overtime finish between the US and Europe as we integrated market systems into the energy discussion internationally

How realistic

One failed thing from the Kyoto protocol was that it didn’t include developing nations while the Byrd Hagel resolution which said that the US must maintain competitiveness in the energy market included those nations so the bill couldn’t pass through congress

On The Global Agenda (p493);

2005 An Economist at the G8 biannual summit on climate change by the name of Nicholas Stern, notices via body language that leaders are either disinterested in the topic or aren't as invested in the topic as they should be, even though host British Prime Minister Tony Blair views this as his most urgent issue (aside from London under attack)

The K word

Since George W Bush was supporting renewable energy at the state level and saying that he would call for mandatory restrictions on “four main pollutants” one of which was CO2, it was believed that he too would address climate change like his opponent Al Gore

Two of Bush’s cabinet members sent him memos and even presented in front of the entire cabinet on their fears and justification of climate change Christine Todd Whitman and Paul O’Neal, and despite their pleading Bush withdrew from the Kyoto protocol

Christine Whitman was the administer to the EPA and was in attendance when Secretary of State Colin Powell while going though the duties of his undersecretary, stopped and giggled when he came to addressing climate change

Twenty one questions

Secretary of Commerce Don Evans- “I remember going to Europe and them saying our administration was leaving Kyoto”

Evans, realizing bush had spread the climate change research budget over 13 agencies who didn’t communicate their findings that he had to do something himself, so he reached out to James Mahoney, a climate modeler by academic training, he had a PhD in Fluid mechanics from MIT where mentor Jule Charney had later gone. Mahoney also served as president of the American Meteorological Society

His job was to focus about 2 billion into the climate change science research program

Page 497 for the 21 questions

The foot and the mouth panic

David King chemistry Professor at Cambridge University was supposed to be mapping Great Britains low climate future but the largest outbreak ever recorded of foot to mouth ravaged their livestock, so King had to attend to this national crisis.

After that King went on to lecture in Britain and globally about the risks of “business as usual” explaining that for the island nation, in the near future the 100 year flood could happen every 3 years because of risen sea levels

Making a market in carbon

the Kyoto protocol only needed 55 countries to sign to be ratified, Vladimir Putin was the 55thsignature, while he joked a few degrees warmer in Siberia would be welcomed, Russia could sell its carbon credits because of its lack of manufacturing for substantial revenues

Richard Sandor, Northwestern Professor economist and consultant who created the market for trading future interest rates, once an alien concept now measured in trillions of dollars a day

Sandor “no matter how good the odds, never make a bet that could ruin you if it goes against you. Why take the risk on climate change if it could end in catastrophe”
Sandor returned to Chicago and setup the exchange trade for carbons known as the Chicago Climate Exchange, after finding 14 participants including the city of Chicago, he realized that the market worked, and that it could be written. Even though the US was out of Kyoto, he also created the European Climate exchange

Today the carbon markets are bigger than anything else, bigger than even crude oil

The Power Of Images

When Katrina and Ruth hit the Gulf of Mexico, nobody was ready for the devastation and along side with the documentary “An Inconvenient truth” which was showed by Al Gore won an academy award

After the IPCC released its assessment in 2008 it concluded that, there was a 90% chance humans were responsible for climate change

Nicholas Stern writer of the “The Stern review of the economics of climate change” defined our failure to address climate change as the biggest market failure in human history

Green Credentials

John Houghton former head of the UK Meteorological office, coleader on the IPCC's first three assessments, talked to the board of directors about climate change in the mid 1990's and convinced the CEO that the threat was real and because of this BP made it a mission to do all it could to "because climate change can't be ignored"
This was also when BP changed its name from British Petroleum to the mysterious Beyond Petroleum. Developing ways to reduce green house emissions as well as alternative energy, establishing an internal CO2 trading system

At the same time most of the American energy companies remained aligned with the global climate coalition, which challenged IPCC

While GE has energy technology ranging from gas turbine plants to nuclear and wind and everything in-between their CEO Jeff Immelt held conferences in their New York office speaking about the environment and climate and after doing so GE launched its eco imagination campaign and accelerated a refocusing of GE and how they conducted business

In this time, the along with other companies GE and BP formed the US Climate Action Partnership or USCAP to promote climate change legislation. As well as the global climate coalition being dissolved after conflicts amongst its members couldn't be handled

The Nobel Prize

December 10th2007, Oslo City Hall, Norwegian Parliament awarded the Nobel Peace Prize jointly to Al Gore and to the Intergovernmental Panel on Climate Change(IPCC)

Rajendra Pachauri- an economist and engineer from India was accepting the award for the IPCC because he was their chairman, under him were 450 authors, 2500 scientific expert reviewers, and 800 contributing authors representing 113 countries, he was also head of the International Association of Energy Economics and in his acceptance speech in 1988 said, ” We can postpone a deeper interest in this subject only at the risk of a continuing insularity and myopia.” He later said, that this Nobel Prize should raise the alarm

Massachusetts versus EPA: Supreme Court steps in

Carol Browner one of Bill Clinton's and later Obama's environmental protection advisor got into it with then senate majority leader Tom Delay, until finally Delay challenged Browner "do you think that the clean air act allows you to regulate emissions of CO2?
Browner replied, " I think we are grant broad authority under the clean air act to,"
Delay, " would you get me a legal opinion on that?"
Browner, "certainly"

In 2001 the incoming Bush administration said that CO2 is not listed as a pollutant on the clean air act

Then the state of Massachusetts sued the EPA for not regulating the greenhouse gases, specifically CO2, coming out of a automobile tailpipes though a court of appeals rules against them the supreme court took on the case. Justice Stephen Breyer said that while one could not prove that regulating tailpipe emissions by themselves would be sufficient, combine that with other measures, "each of which has an impact, and lo and behold, Cape Cod is saved." The court rules 5-4 that Massachusetts had ground because of possibility of actual and imminent danger

In Search Of Consensus (p509);

In 2008, Barracks first official speech as president of the united states was actually about climate change, “the days of Washington dragging its feet are over, America will not be held hostage to a warming planet.”

His cabinet, Henry Waxman, chairman of the Energy and Commerce committee, Edward Markey, chairman of the select committee on Energy Independence and global warming

Markey has had climate change on is agenda for all of his 33 years in congress, in his office is a new paper, from November 7th1976 with the right hand head line “Natural Gas supply cut short” and the left hand article, is an interview with a professor from the university of Pennsylvania, warning of coming world crisis one of them being “world changing climate”
Markey also said in 1987 that the US could be a fully solar society by the year 2030

Carrot and sticks

Markey and Waxman had a two-part strategy to in reshaping the economy, first was to bring people on board with inducements, that cap and trade had in terms of handing out allowances for free to specific industries, rather than auctioning them off. This was the carrot and it represented $1 billion. The second part was the stick, this was the EPA as Markey put it “it was legislation verse regulation” one utility CEO referred to it as the bayonet.

Together they also build the telecom industry to where the market rules ensuring low prices for consumers and fair competition to firms

A bill introduced by Markey called for an 83% carbon reduction from 2005 to 2050

Even with critics saying the energy industry couldn’t handle change that fast the bill passed though the house, 219-212

China: Win-Win

Per capita china’s energy usage is less than that of the US and Europe, second it is still relatively poor and has a low standard of living and must have same chance to increase their own peoples lives, while air quality is a major issue there the Chinese government is planning to switch all coal with natural gas

That being said china is also has the greatest solar power potential than anyone else and sports the largest hydroelectric dam

The Climate Agnostic

India produces 5% of global CO2 while China produces 23%

India's Prime minister says that while they didn't help crate the problem of global warming but is committed to being part of the solution

Hopenhagen

Copenhagen, COP 15 the first an attended by President Obama, instead of the 300 + countries of the UN only included the majority holder of world GDP and thus the biggest polluters too, there they came to a no contractual deal to reduce green house emissions

The Health of The Himalayas

The IPCC gets called out by India for saying one of the glaciers in the Himalayas will be gone in 20 years, and that this wasn't actually scientifically proven but rather taken from an interview with a scientist from the region after this in 2009 statistically world wide public opinion is down for global warming and for climate change policies

Extreme Weather

Weather events from droughts here in the US to flooding in parts of the world that don’t see more than a couple inches of rainfall every year, Russia, experiencing an unusually hot day over 100, lost 1/3 of its wheat crop, a temperature that they haven’t seen in 50 or100 years

From carrots to sticks

after Copenhagen the US agreed to reduce 17% of emissions from 2005 by 2020

after Massachusetts sues the EPA it overhauled itself and no covers emissions from automobiles, power plants, and refineries

in 2012 the EPA rolled out standards for power plants, and refineries these limit CO2 and Electricity generated but then numerous states didn't cooperate with the EPA and Rick Perry governor of Texas even went as far as to say he wasn't going to follow them and now

PS Rick Perry is now the secretary of Energy

The Legacy of Glaciers

We have come a long way since John Tyndall was studying glaciers in the alps, and a long time since Svante Arrhenius or Fourier thought about the relationships that we deal with on the day to day.

Charles Keeling meteorological experiments in Hawaii were the first to see rising CO2 levels in the atmosphere and because of him we know how much we have been accumulating since the industrial revolution, with knowledge of the keeling curve hopefully we can avoid turning into venus

Though energy policy, and other sustainable tools hopefully we can make the earth last well past 2100