



Global Warming Wars and Fossil Energy

Current and Future Realities

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www.spe.org/dl

Outline



- Greenhouse gases and effects
- Science and politics; ongoing battles
- Very difficult challenges; technical and political
- U.S. policy converging on carbon tax
- Opportunities for the petroleum industry

Greenhouse Gases



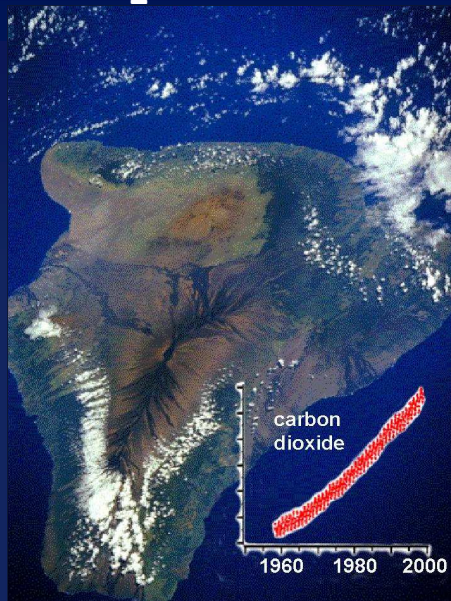
- Act like glass in a greenhouse
- Control infrared solar energy entering/leaving atmosphere
- Without these gases, T_{air} would be -18°C , not $+15^{\circ}\text{C}$
- Water vapor
- Carbon dioxide
- Methane, hydrates
- Ozone
- Nitrous oxides
- Some synthetics

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1 Concern: Rapid CO_2 increase



- Well documented increase of CO_2
- Correlates with T

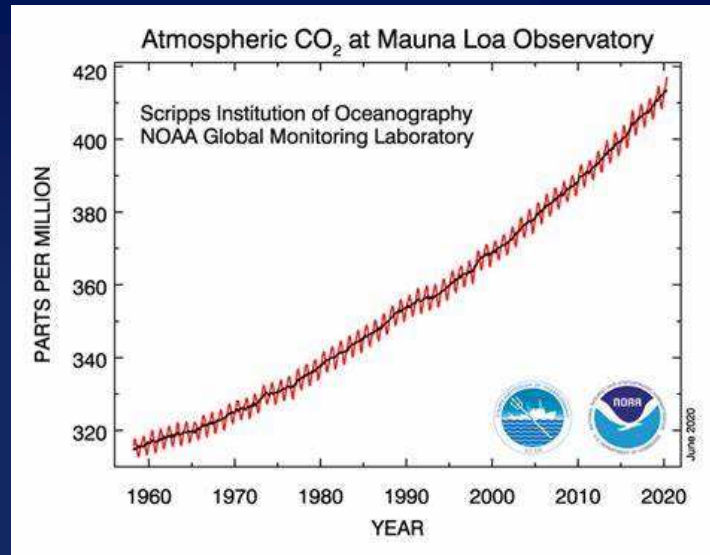


Source: NOAA

Atmospheric CO₂ at Mauna Loa, Hawaii



- Precisely measured, well established, rise of CO₂



Courtesy: NOAA

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Shouting match between the political and environmental left and right



- The left (believers) Demand curbs on smokestack and tailpipe heat trapping gases
- The right (sceptics) See global warming between an irritant and a hoax
- Recent developments A “warming” trend between the two camps; move to pragmatism

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IPCC -- led by U.N.

- Financed by IPCC Trust Fund (governments)
- Emphasis on modeling

NIPCC -- led by sceptics

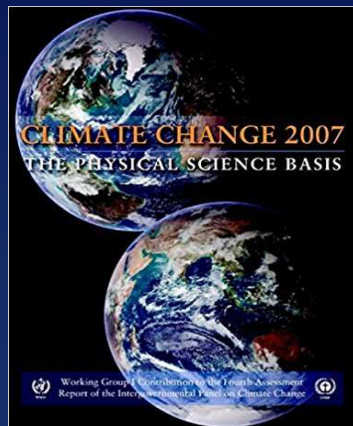
- Financed by corporate and private interests
- Emphasis on measurements

Neither does their own research.
Both claim assessment based on published literature and peer-reviewed sources.

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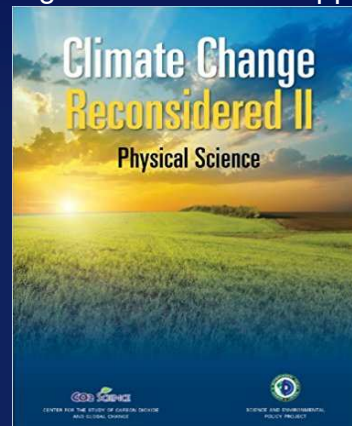
Is there more than one legitimate perspective?

IPCC
(UN sanction and support)



Climate change **due to human** activity

NIPCC
(No govt. sanction or support)



Human activity has **minor impact**

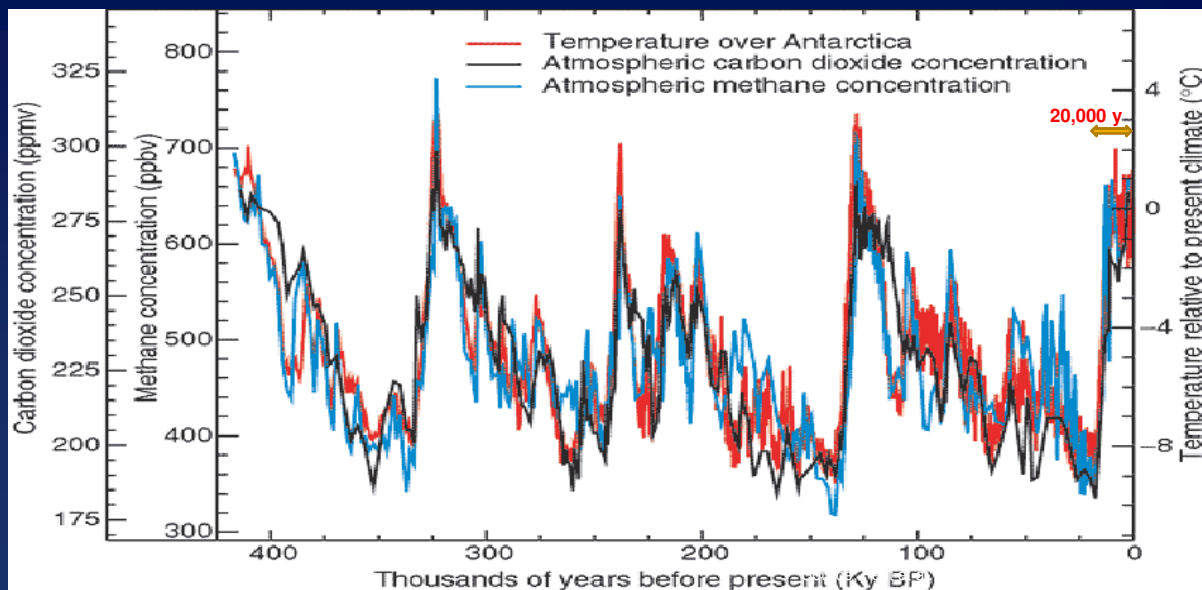
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Step Back in Geologic Time

With complex systems,
the key to predicting future lies
in understanding the past

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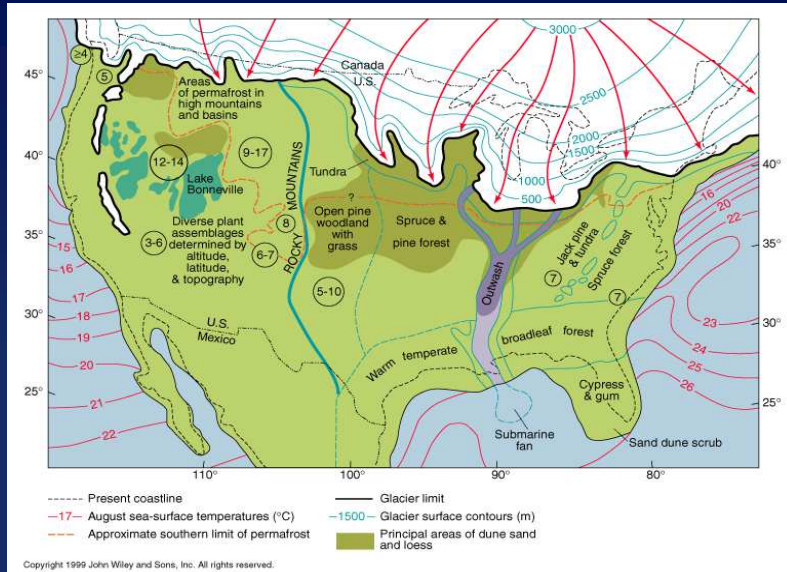
Correlation of Global T, CO₂ CH₄ over 400,000 years



N. America's Topography – 20,000 years ago



- America's last glaciation (ice thickness in m)
- Greater coastlines because sea level was 400 ft lower



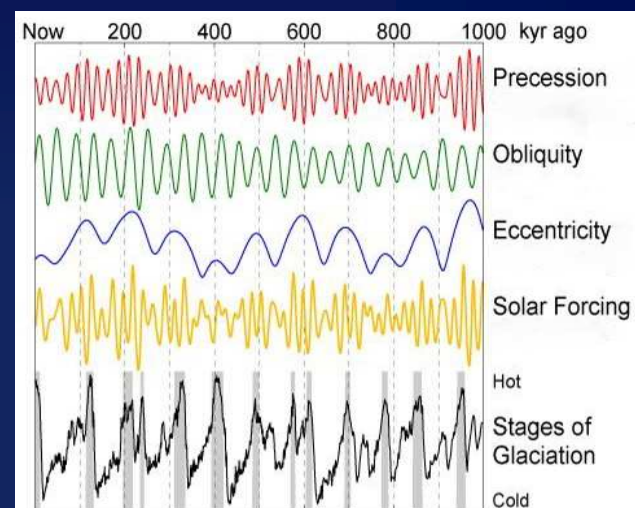
Courtesy: John Wiley and Sons, 1999

Astronomers: Three Natural Forces That Together Lead To Periodic Ice Ages on Earth



Changes of Earth's orbit:

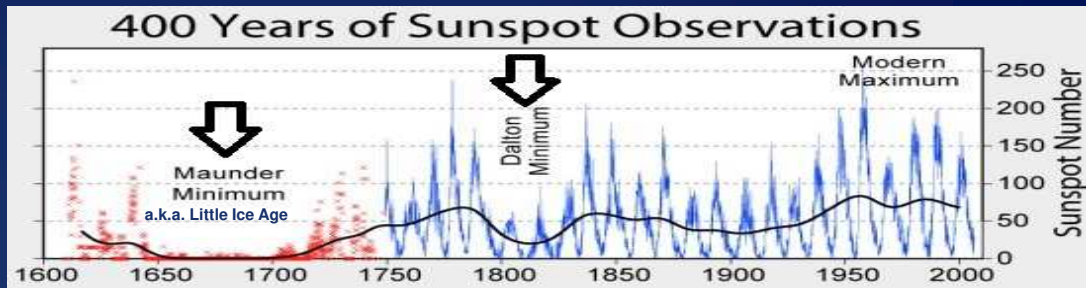
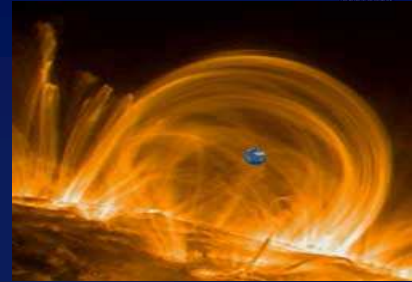
- ✓ **Shape:** Earth's orbit elongates every **100,000** yrs (eccentricity)
- ✓ **Tilt:** Earth's axis changes 22° to 24° every **40,400** yrs (obliquity)
- ✓ **Wobble:** of axis (precession) in a circle every **23,000** yrs
- ✓ **Solar forcing:** variable



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The Heartbeat of the Sun

- Well established solar cycles – 11 years
- Longer and unknown solar cycles?
- Solar Magnetic Waves



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Frozen River Thames, Maunder Minimum, 1693



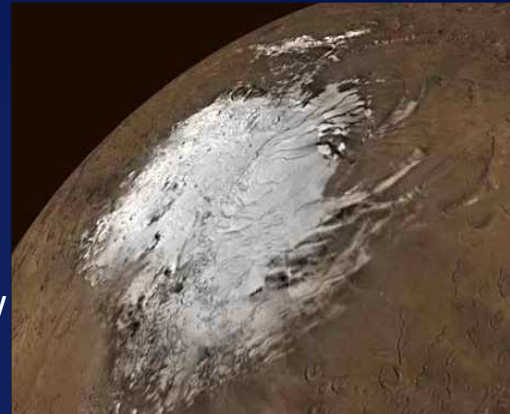
Source: The Museum of London

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“Mars Melt Hints at Solar, Not Human Cause for Warming”



- Global warming on Mars??
- From NASA's Mars Global Surveyor and Odyssey missions
- CO₂ "ice caps" near Mars' south pole diminishing for three summers in a row (Danish, Russian, Israeli scientists)



National Geographic, Feb 27, 2007

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IPCC's conclusions (U.N. -2018)



- Human influence on climate system is clear
- Surface T projected to rise over the 21st century under all emission scenarios (modeling)
- Oceans to warm, acidify, sea level to rise
- Rain/drought events to become more intense
- Impact on fauna and flora
- Climate change beyond 2100 – **irreversible**

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The *Inconvenient* Scientists (“Sceptics”)



- Feel being intimidated into silence
- Claim that their grants disappear, their work derided, labeled as industry stooges
- Most are retired; need no grants
- Claim that alarm, not genuine scientific interest appears essential to maintaining funding

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Reaction of the Petroleum Industry



- Changing attitude; a reflection of political reality
- Industry has long opposed emission constraints; now cooperate on structuring rules
- Now discuss who and how to pay for CO₂ sequestration
- Recent trend: push to simplify rules (deconstruction)



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Reaction of SPE members

From discussion on 



“SPE Connect” posts on climate change (informal % count:)

* **Neutral*** – 46% **Believers** – 25% **Sceptics** – 29%

* No detectable leaning, e.g. focus of CO₂ disposal, etc.

- “Climate science and policy are outside of SPE’s core competencies; SPE is recommended to draw on information from other competent sources”

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2021 SPE President on climate change



- “ I am absolutely unqualified to comment on climate change, however, given the things we have done to this planet, I am sure it is not happy with us”
- Hydrocarbon-based economy is “sustainable” for 100 years +
- But we must emphasize energy transition. “Transition now”
- “To say that we are not going to change is unacceptable”
- Argues for evolution of petroleum engineering curricula

JPT; September 2020; six pages

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OIL & GAS JOURNAL WASHINGTON PULSE MAGAZINE PAST ISSUES

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EIA data show 2.5 million-bbl US oil inventory drop | UK oil and gas survey notes confidence

Oil companies in group seeking carbon tax

HOUSTON, June 21
06/21/2017
By OGJ editors

Four major oil companies have joined a nongovernmental initiative to impose a carbon tax in the US as a precaution against catastrophic climate change.

The Climate Leadership Council, which was launched in February by a group of former officials of Republican administrations, listed BP PLC, ExxonMobil Corp., Royal Dutch Shell PLC, and Total SA in a June 20 disclosure of founding members.

The CLC advocates a tax beginning at \$40/ton of carbon-dioxide emissions and increasing over time.

Proceeds of the tax would be returned to Americans via monthly dividend checks and be accompanied by border adjustments favoring non-US countries with comparable carbon-pricing systems and by elimination of regulations made unnecessary by carbon pricing.

Other corporate founding members are GM, Johnson & Johnson, P&G, Pepsico, Santander, Schneider Electric, and Unilever.

The CLC also reported two nongovernmental organizations as founding members: Conservation International and The Nature Conservancy.

U.S. policy converging on carbon tax

- Concept: put price on CO₂; consumers will find thousands of ways to cut emissions
- Avoids myriad of gov. regulations; shrinks gov. size
- Peg tax at \$40/ton of CO₂; equiv. to ~36c/gal
- Tax money would go to citizens, not gov. revenue
- “Carbon dividend” to a family of four ~\$2,000/yr
- Expect fights from industry, esp. coal

Bipartisan carbon fee and dividend bill now before U.S. Congress



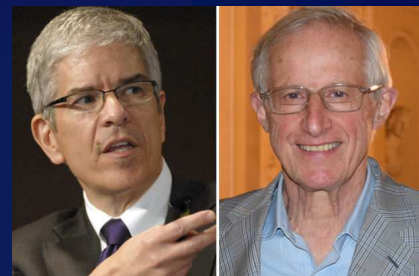
- “U.S. Senators unveiled carbon tax bill to generate \$2.5 trillion in 10 years
- It would rebate 70 % of the money to families and use the rest for energy infrastructure
- Steadily rising fee and dividends; projected to reduce greenhouse gas emissions 90 percent by 2050

Reuters, July 2019
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Two Top U.S. Economists Win Nobel for Work on “Growth and Climate”



- “There are billions of people, millions of firms, thousands of govts., hundreds of nations. For them to act, they must have incentives”
- “We can raise prices of goods and services that are carbon intensive and lower the ones that are less carbon intensive.”



Source: WSJ; Oct 10, 2018

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Shortcomings of the Paris agreement



- Based largely on political imperatives
- Pledges were voluntary, submitted in advance
- All were accepted without scrutiny
- Pledges did not have to mention emissions levels
- There were no penalties for falling short

Source: Wall Street Journal, June 2017

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The world is losing war against climate change*

Why??? Three major reasons:



- Soaring energy demand, esp. developing countries
- Economic and political inertia. Powerful lobbies, huge investments made by banks; can cripple the banking system if investments fail
- Not just power generation: steel, cement, farming, transport; generate >1/2 of global CO₂ emissions; technically harder to clean than power generation

*Credit: The Economist, August 4, 2018

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Oil and Gas Climate Initiative (OGCI)



- Voluntary, CEO-led initiative, established in 2014 by ten (now 13) major oil/gas companies
- Aim: reduce CH₄ and CO₂ emissions, recycle or store carbon dioxide; a \$1B+ fund



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Public pressure matters



- “Shell to link carbon emissions to executive pay, **capitulating** to investor pressure” (WSJ; 12/4/18)
- “Norway’s \$1 trillion pension fund wants out of oil stocks” (CNN, 4/16/18)
- California mandated carbon-free electricity by 2045 (WSJ, 9/17/18)
- Majors to reduce oil exploration, begin to diversify into renewable energy (WSJ, 7/14/18)
- “**Investor pressure** could change what it means to be an oil and gas company” (JPT; 7/20/18)

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Why so hard to change? Economics!



- France, imposed taxes on fuel to fight climate change; faced riots; had to back off
- The Extinction Rebellion, in London: “Tell the Truth”
- Voters in liberal Washington state have twice rejected higher tax on fuel
- Fuel almost free in Venezuela; fear of raising prices/taxes; fear of riots



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Carbon Capture and Storage



- CCS challenges not only technical, but economic, legislative, winning public acceptance
- EOR -- first step to a CCS business, but limited by scale, geography. Short term solution. <1%*
- Deep saline formation below 1000m likely main type of storage in short/mid term
- Other options: not many and not attractive

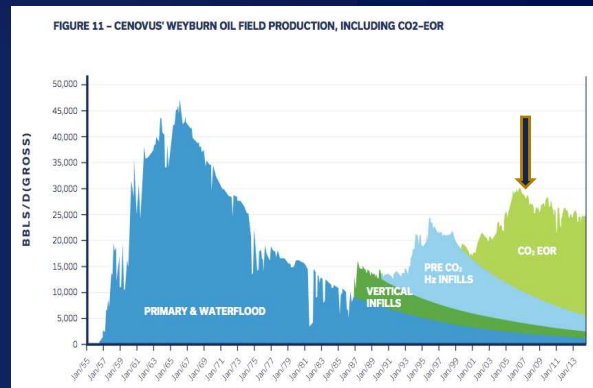
*Sunil Kokal, JPT, July 2017

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Example: EOR/CO₂ Sequestration



- CO₂/coal gas. plant in ND, captured, compressed, pipelined, injected to depleted oil field in Weyburn, Canada
- CO₂ flooding and long-term storage
- CO₂ misc. dominate EOR



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Methane, the hot gas...



Two major sources of methane:

- Natural sources (30%): wetlands, termites, oceanic processes, other minor sources
- Anthropogenic sources (70%): fermentation in ruminant animals, rice cultivation, biomass burning, landfills, coal mining, sewage treatment
- Methane is 21% more potent than CO₂; role of methane hydrates

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Quotable

— Bill Gates on tech innovations to battle greenhouse gas emissions

Solar panels are great,
but we should be hearing
about trucks, cement,
and **cow farts, too.**



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(Ryan Rodrick Beiler/Shutterstock)

German barn explosion caused by 90 farting cows

On the many dangers of methane gas



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Measuring greenhouse gas emissions

BBC News, U.K. Edition



- Farmers in New Zealand disgusted at gov. plans to impose animal "flatulence tax"
- Sending parcels of cow manure to members of parliament
- Angered postal workers: smelly packages to pose health risk
- Also testing sheep for CH₄ production



Source: NZ newspaper, 2012

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2020 ELECTIONS: Biden unveils \$1.7T climate plan

(POLITICO; 06/04/2019)



- Plan would pour \$1.7 trillion of federal money into clean energy over a decade to bring U.S. greenhouse gas emissions to net zero by 2050
- Major theme in the presidential race. Would refuse donations from fossil fuel interests
- Would demand Congress pass climate change legislation to enforce reducing emissions, make a "historic investment" in climate research and encourage "rapid deployment of clean energy" to achieve net-zero emissions by mid-century.

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Some comments to the article



- Plan entirely made up by environmental idiots and embraced by lunatics
- They will find fault with anything that works and would be financially sound
- Global warming – religion of the 21st century

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Trends to watch



- New Chief Executive of BP promised to cut net emissions to zero by 2050, in a reversal of the London-based company's previous stance
(WSJ: 8/5/2020)
- Germany has allocated \$10 billion to its nascent hydrogen industry to satisfy its climate commitments (JPT, August 2020, p. 20)
- Investors continue to bet on the potential of electric transportation (WSJ 8/4/2020)

WSJ and JPT

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Hot off the press...



- The global energy system to undergo fundamental restructuring to decarbonize
- Last year, BP theorized that peak oil demand could occur by 2030
- This year BP's Energy Outlook says, global use of oil may have already occurred in 2019
- BP's strategy: prepare to transform into a diversified energy company
- Fossil fuels accounted for 85% of primary energy demand in 2018: by 2050 it may represent only 65 to 20% of the share
- "This would be entirely unprecedented in the modern history of energy"
- BP and Equinor to build large windfarm projects to produce 4.4 GW, enough to power 2 million homes along the US East Coast

BP 2020 Energy Outlook

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U.S. Government Funding of Climate Change



- Total U.S. expenditures on climate change from FY 1993 to 2014: **\$166 billion** (2012 \$\$)
- By comparison:
- Congressional Budget Office estimated the entire Apollo program, from 1962 to 1973 (17 missions; 7 with men to the moon and back) -- cost **\$170 billion** (2005 \$\$)

Source: Kenneth Haapala; "U.S. Government Funding of Climate Change" Capital Research Center, Washington, D.C.

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Good News for Petroleum Engineers/Geologists



- Long term CO₂ storage -- political reality
- We are leading source of expertise for subsurface injection of any fluids. Massive projects will be required; many opportunities, new businesses; specialized services. Most of these will fall on our shoulders
- Oxy Forms a New Company to Pull CO₂ From the Air*

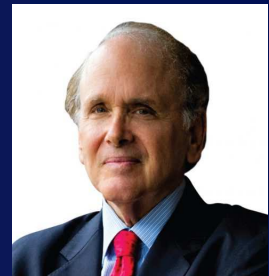
* SPE/Health, Safety and Env. website, Aug 19, 2020

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The New Geopolitics of Energy- Daniel Yergin



- World shifting away from using oil, gas and coal
- Transition will bring major changes in global power
- China poised to be a big winner
- Russia and Middle East exporters the big losers
- U.S. to fall somewhere in between
- “Energy transition” – shorthand for how to get there
- Target for getting there is “net carbon zero” by 2050
- Goal already accepted by E.U., Britain, Japan, others



Feature article, WSJ 9/13/2020

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Geopolitics of Energy- Daniel Yergin (2)



- Joe Biden has pledged to put U.S. on “an irreversible path to “net zero emissions”
- Unveiled his vision this July for “clean energy future” – a \$2 trillion plan backed by an “enforcement mechanism”, which aims to eliminate carbon emissions from electricity by 2035, and to get to “net zero carbon” by no later than 2050

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Green Transportation



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President Trump's visit to the fire-ravaged West Coast reignites climate fight



- “Climate crisis intensified West Coast fire season; scientists say it could get worse”
- “Biden Calls Trump ‘Climate Arsonist’”
- “Apocalyptic fires and global warming”



Newspaper titles from yesterday: 9/14/2020

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Conclusions, Current, Future Trends



- Near term: favor cheap NG, reduce CO₂/CH₄ emissions, LNG
- Mid term: environmentally acceptable ways to utilize heavy oil, “clean coal,” renewables
- Long term: permanent solution to CO₂ sequestration; **not an option -- it's a must**
- ✓ Renewables significant, but will not replace HC
- ✓ Pressure to address global warming to grow
- ✓ The global climate change wars “new normal”

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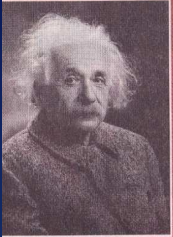
January 22, 2017 • THE WASHINGTON POST

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YOU START DYING.”**

Take advantage of SPE's multiple learning opportunities- Albert Einstein

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