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**The SPE Foundation through member donations
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Global Warming Wars and Fossil Energy

Current and Future Realities

George Stosur

Consultant, Formerly U.S. Department of Energy



Society of Petroleum Engineers
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Outline

- World supply/demand for Fossil Fuels
- Linkage to global climate change
- Greenhouse gases and effects
- Science and politics; ongoing battles
- Very difficult challenges; technical and political
- Opportunities for the petroleum industry

Shouting match between the political and environmental left and right

- The left (believers) Demands 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

IPCC -- led by U.N.

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

NIPCC -- led by sceptics

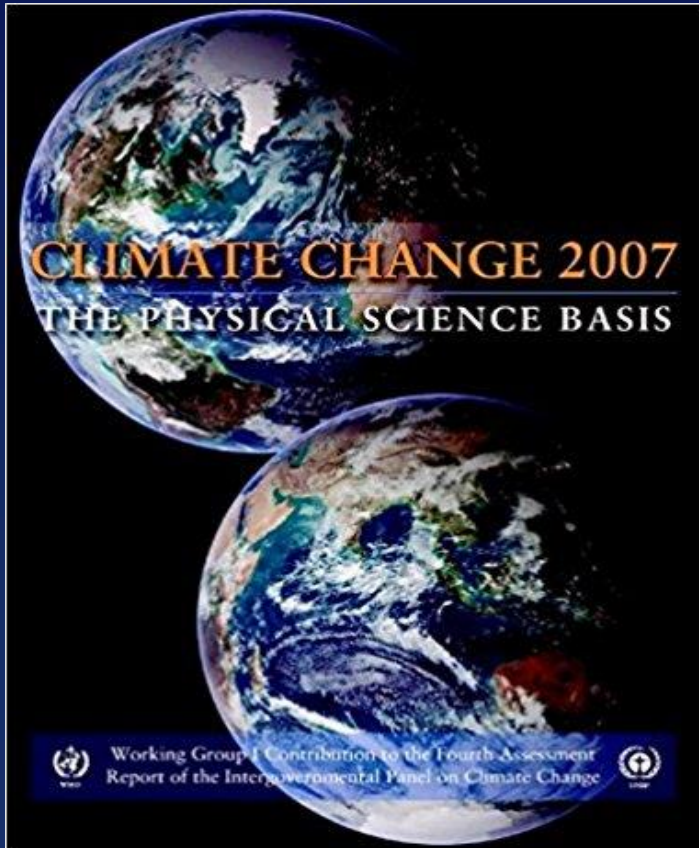
- Financed by corporate and private interests
- Emphasis on measurements

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

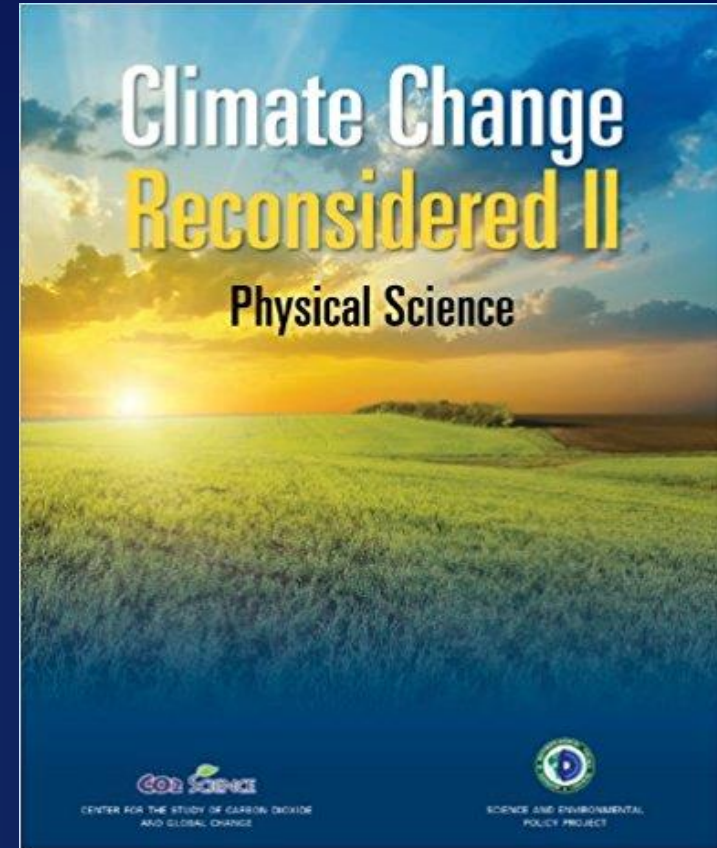
Is there more than one legitimate perspective?

Intergovernmental Panel on
Climate Change (IPCC)
(UN sanction and support)

Non-governmental Int. Panel on
Climate Change (NIPCC)
(No govt. sanction or support)



Climate change **due to human** activity



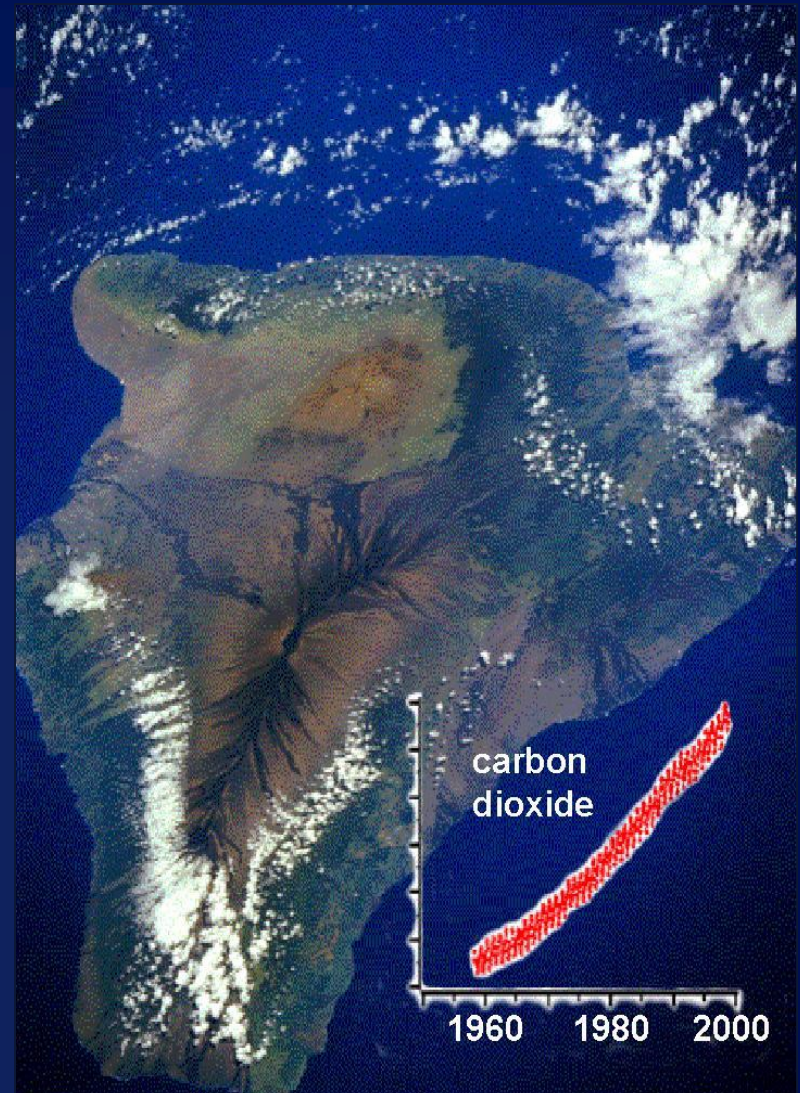
Human activity has **minor impact**

Greenhouse Gases

- Act like glass in a greenhouse
- Control infrared solar energy entering/leaving atmosphere
- Without these gases -- avg. Tair would be -18°C, not +15°C
- Water vapor
- Carbon dioxide
- Methane, hydr.
- Ozone
- Nitrous oxides
- Some synthetics

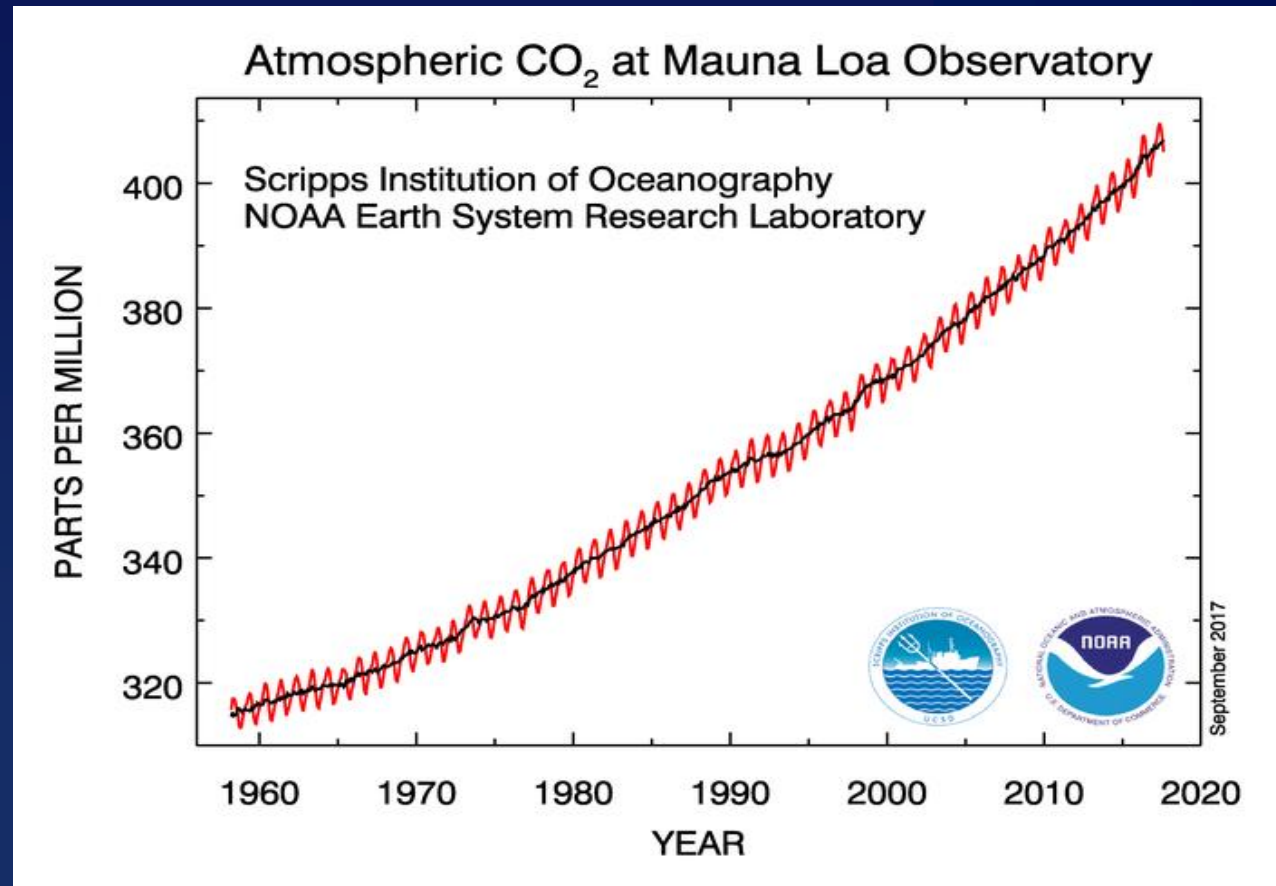
1 Concern: Rapid CO₂ increase

- Well documented increase of CO₂
- Correlates with T



Atmospheric CO₂ at Mauna Loa, Hawaii

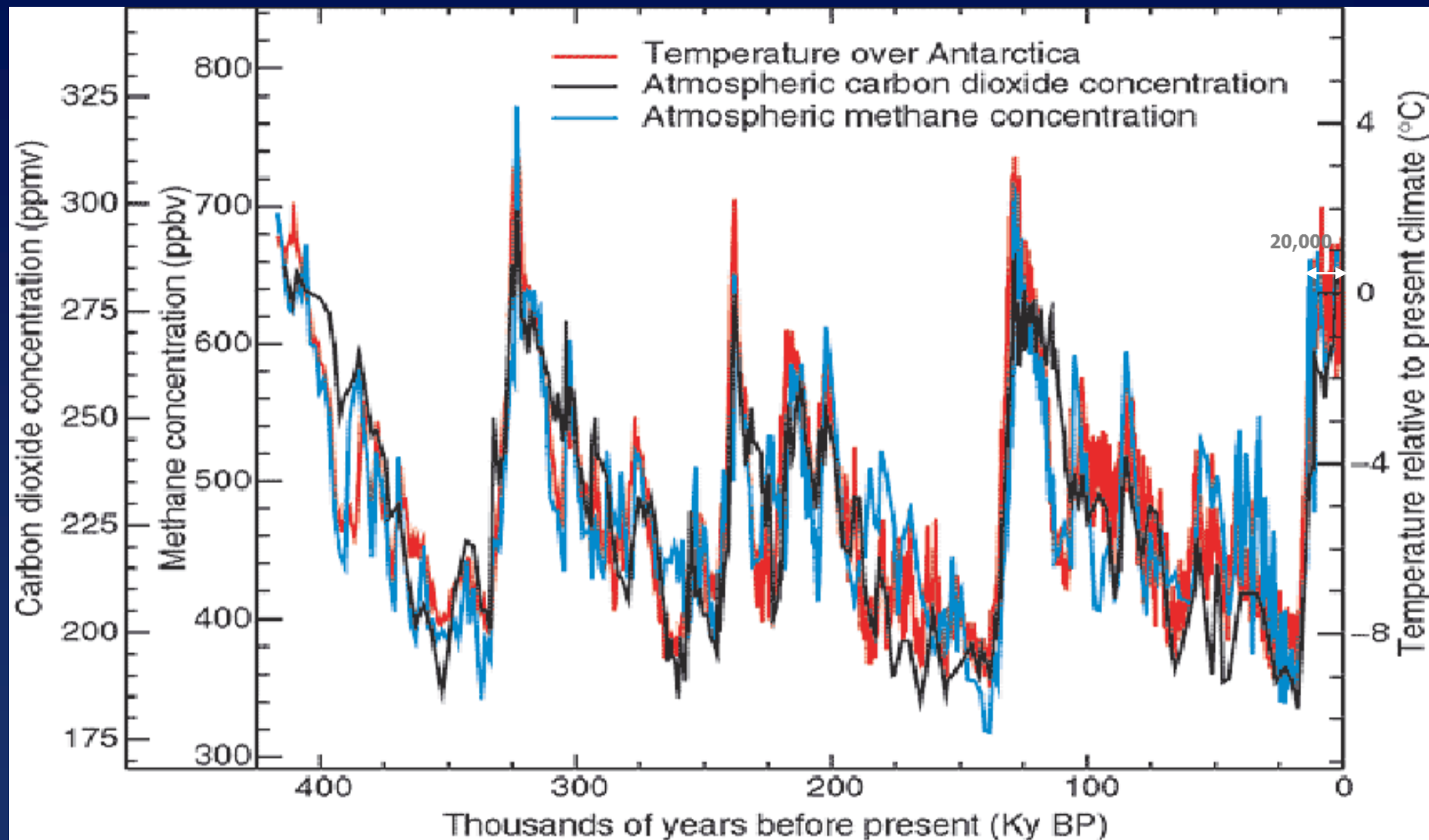
- Precisely measured and well established rise of CO₂



Step Back in Geologic Time

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

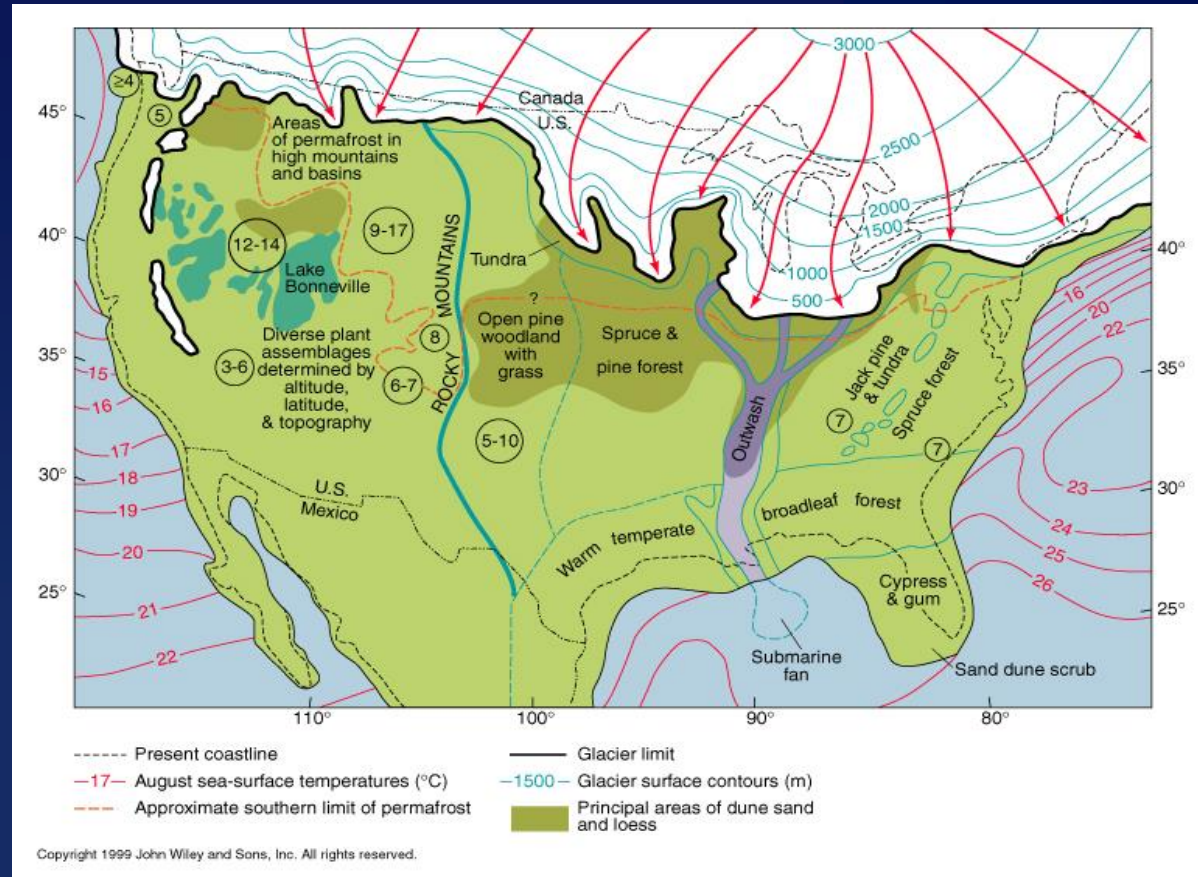
Good correlation of Global T, CO₂ CH₄ over 400,000 years



Source: Petit et al. 1999; Nature, 399-429; IPCC

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

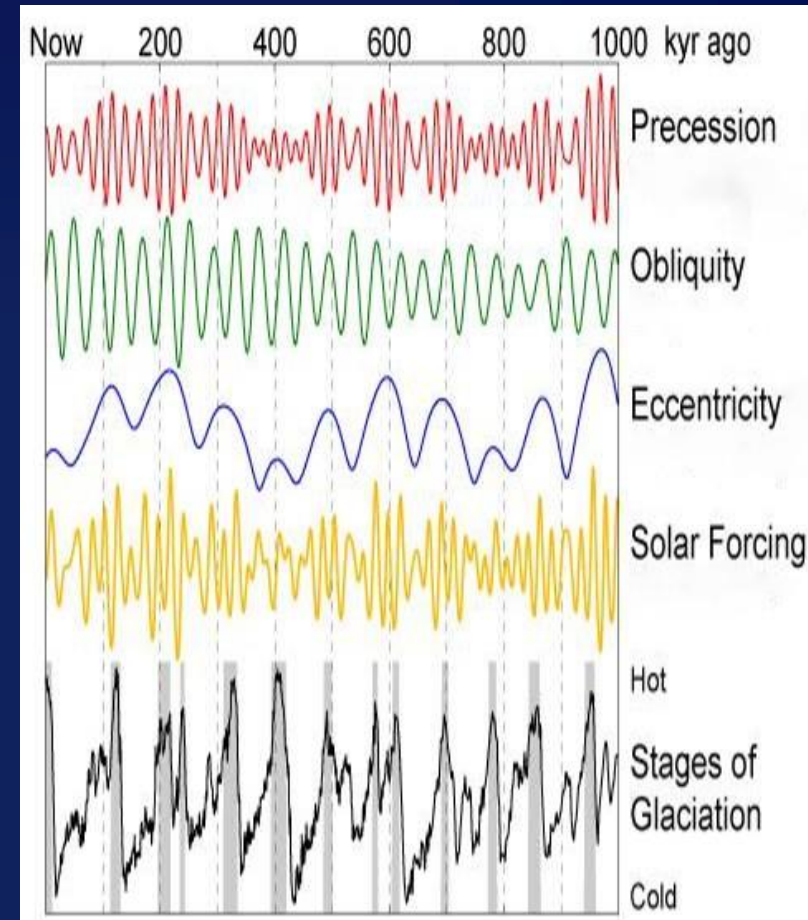


Courtesy: John Willy and Sons, 1999

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

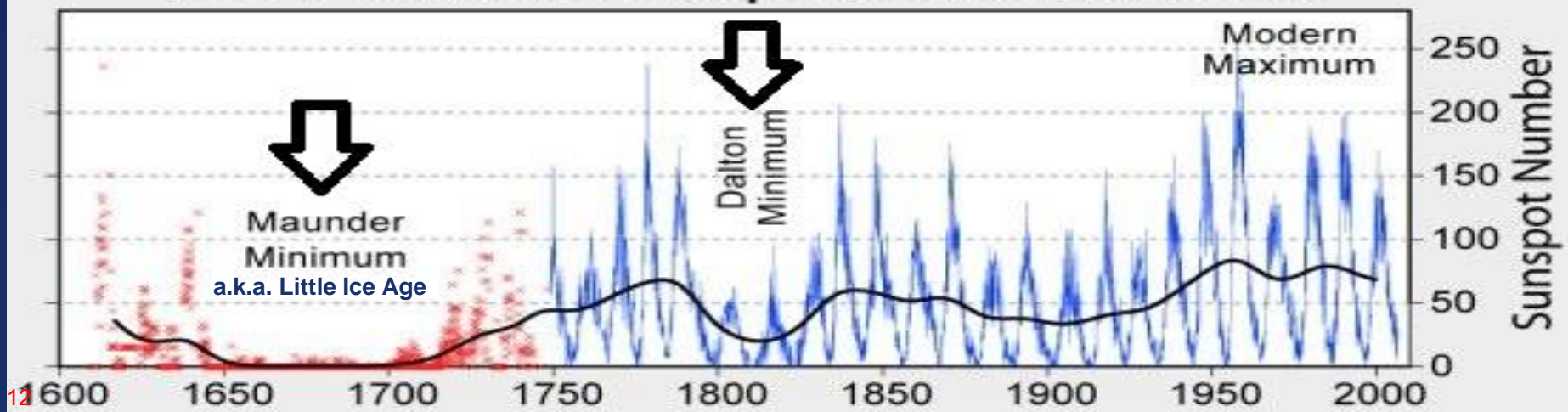


Solar Cycles

- Well established solar cycles – 11 years
- Longer and unknown solar cycles?
- Solar Magnetic Waves
 - Mini Ice Age predicted 2021 to 2054?



400 Years of Sunspot Observations



Frozen River Thames, Maunder Minimum, 1693



IPCC's conclusions (U.N. -2014)

- 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

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

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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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](#).

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.

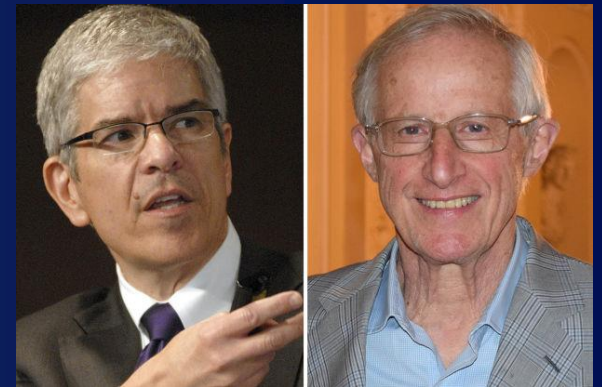
- The SPE Climate Change Task Force recommended that SPE should not develop a public position statement on climate science and climate change because "SPE does not have technical expertise or mandate for assessing climate science or guiding policy"
- "Climate science and policy are outside of SPE's core competencies; SPE is recommended to draw on information from other competent sources"

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

Two Top U.S. Economists Win Nobel for Work on **Growth and Climate**

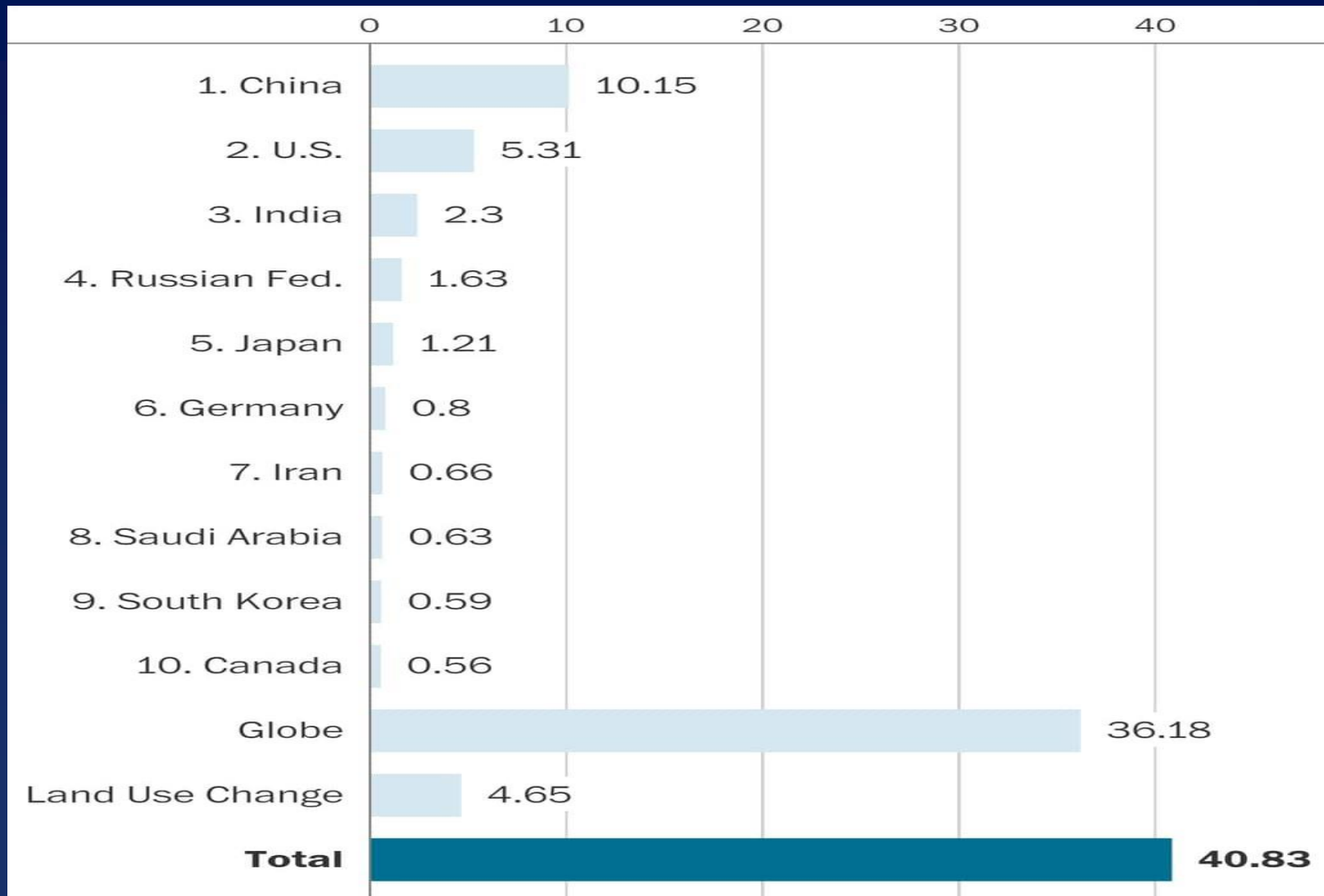
- “There are billions of people, millions of firms, thousands of govs., hundreds of nations. For them to take action, they **must have incentives**”
- “We can raise prices of goods and services that are carbon intensive and lower the ones that are less carbon intensive.”



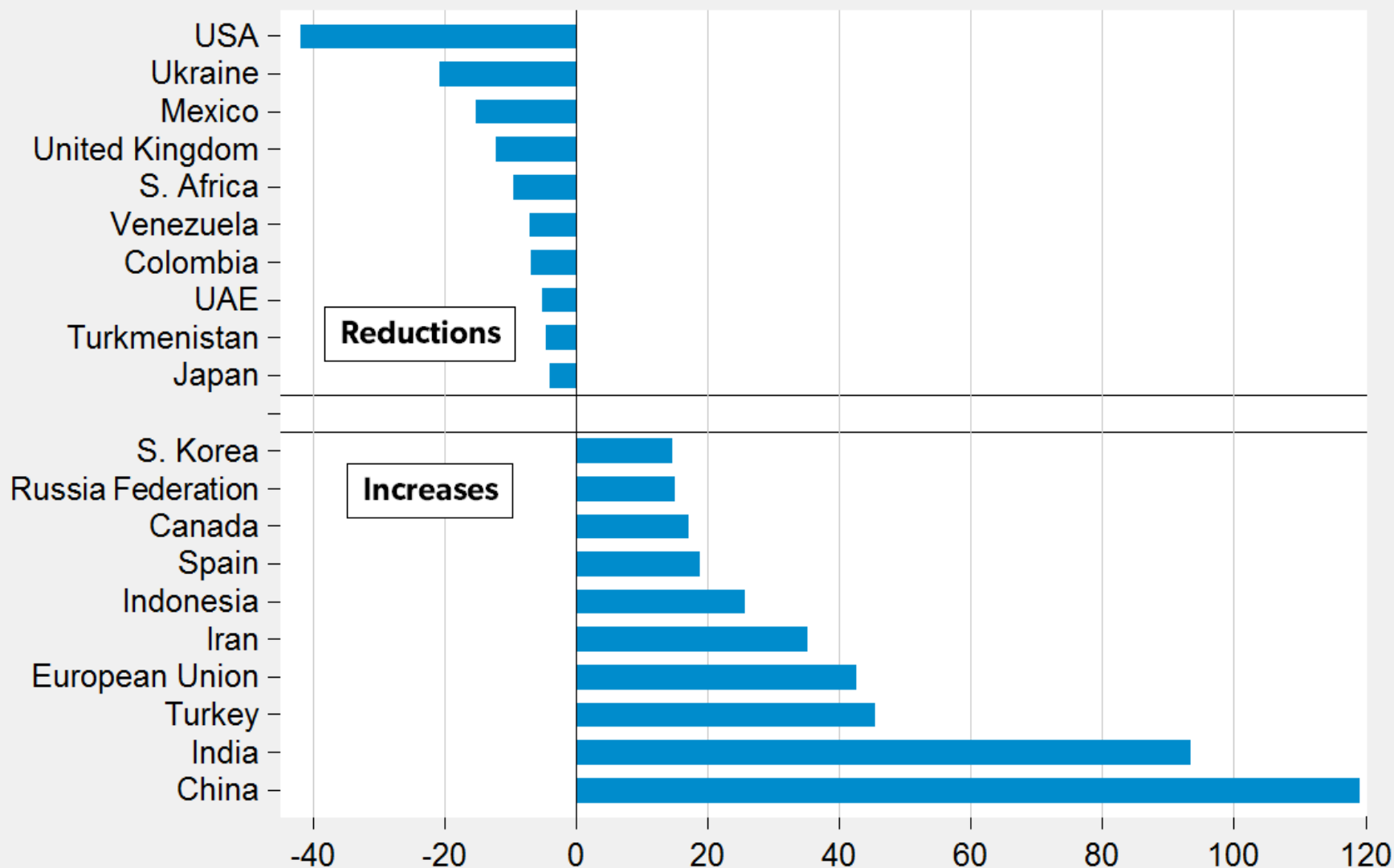
Hot off the press

- “Senators to unveil 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

Top 10 CO₂ Emitting Countries (billion tons/y)



Ten Countries with the Largest Reductions and Increases in CO2 Emissions (Millions of Tons), 2017



Source: BP Statistical Review of World Energy June 2018

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

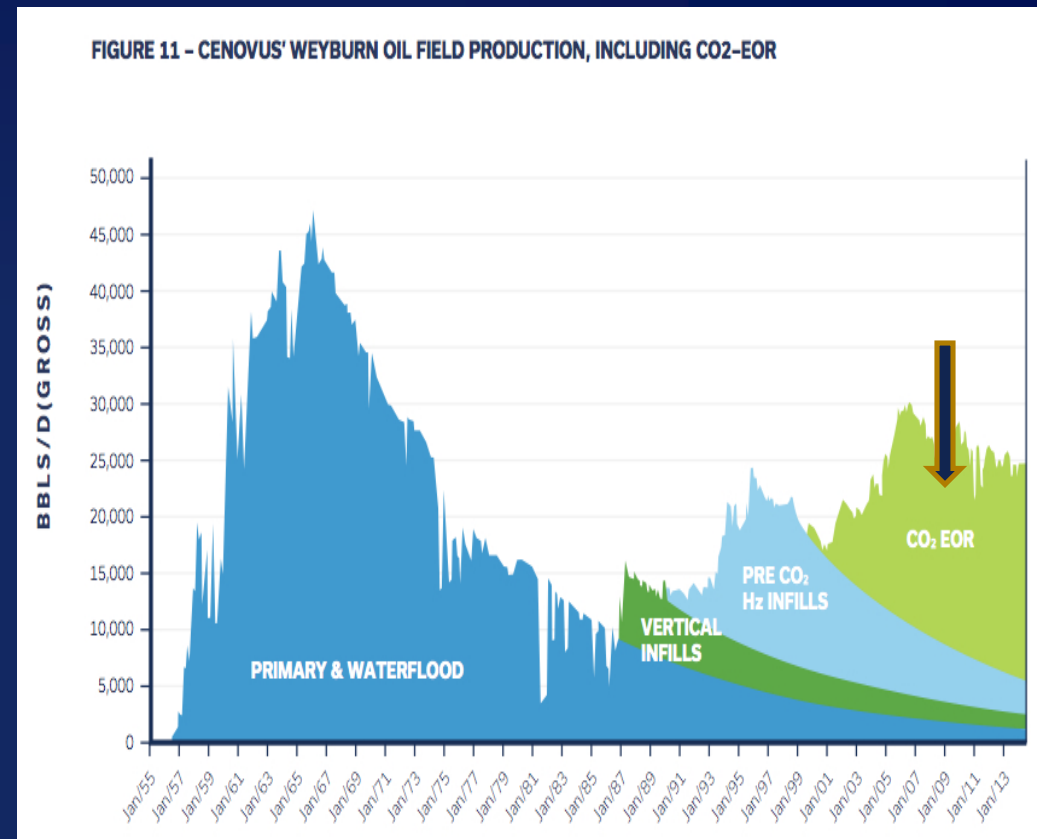
Good News for Petroleum Engineers/Geologists



- Long term CO₂ storage -- political reality
- We are leading source of expertise for subsurface injection of any fluids
- Massive projects required; many opportunities, new businesses; specialized services
- Most of these will fall on our shoulders

Example: EOR/CO₂ Sequestration

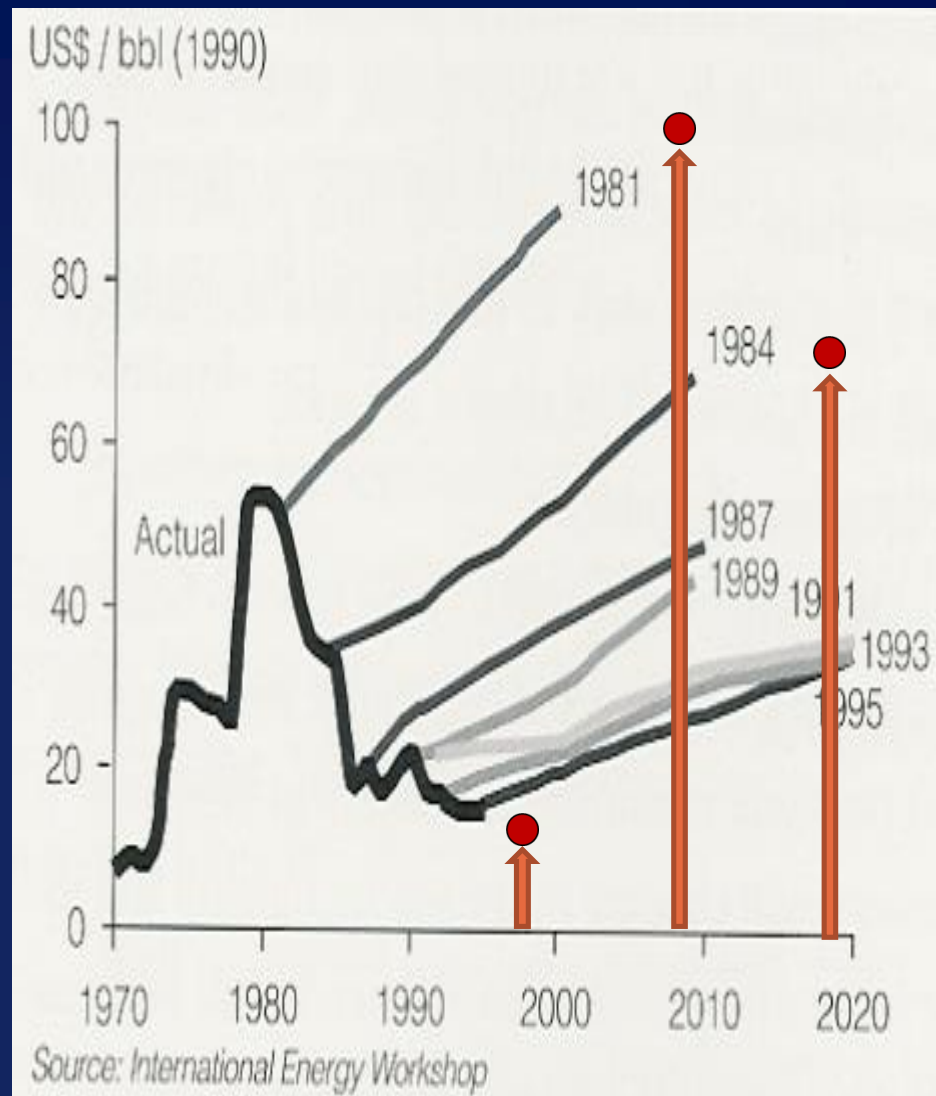
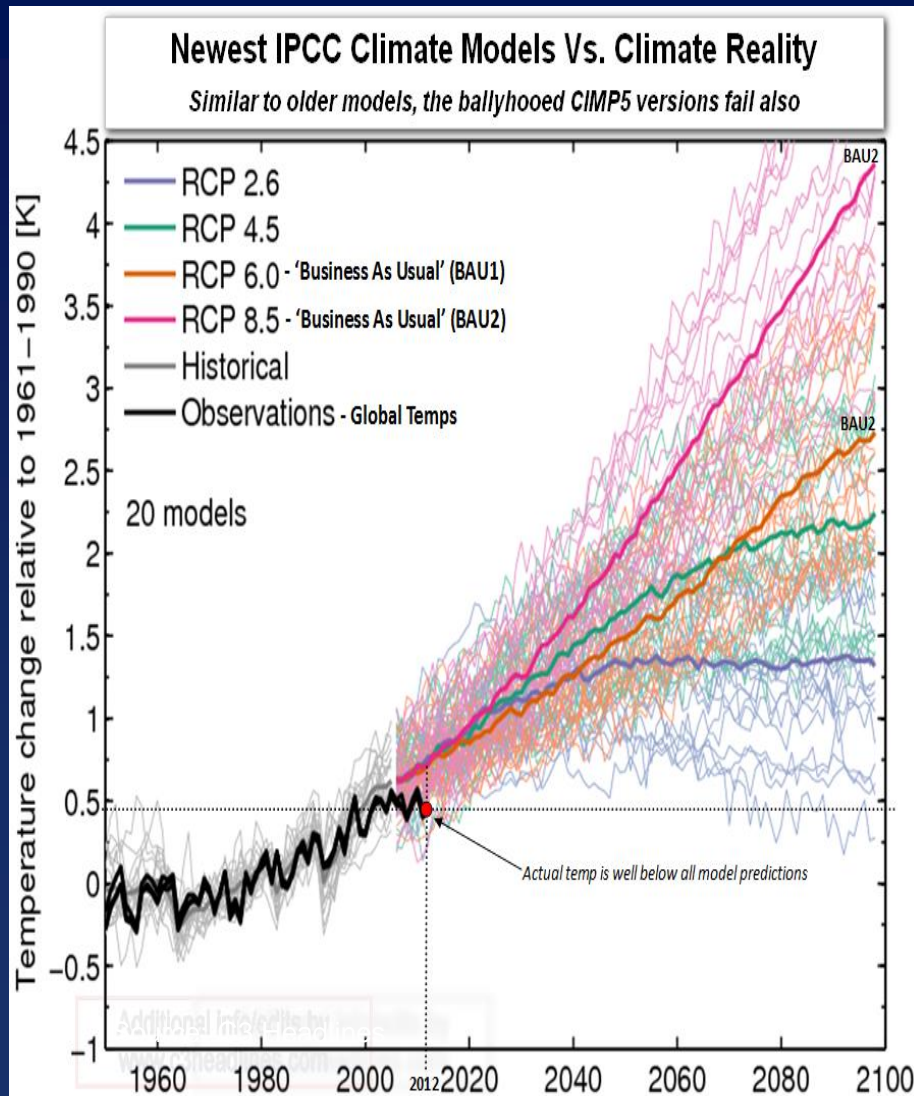
- CO₂/coal gas. plant in ND, captured, compressed, pipelined, injected to depleted oil field in Weyburn, Canada
- CO₂ flooding and long-term storage
- CO₂ misc. dominate U.S. EOR; 139 active



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

“Those who rely solely on forecasting in their thinking about the future, can find the consequences very expensive”



2019 SPE President Offers a Vision of Oil and Gas Sustainability

- Outlined the focus of his year-long tenure
- Future image of our industry; promotion of energy sustainability

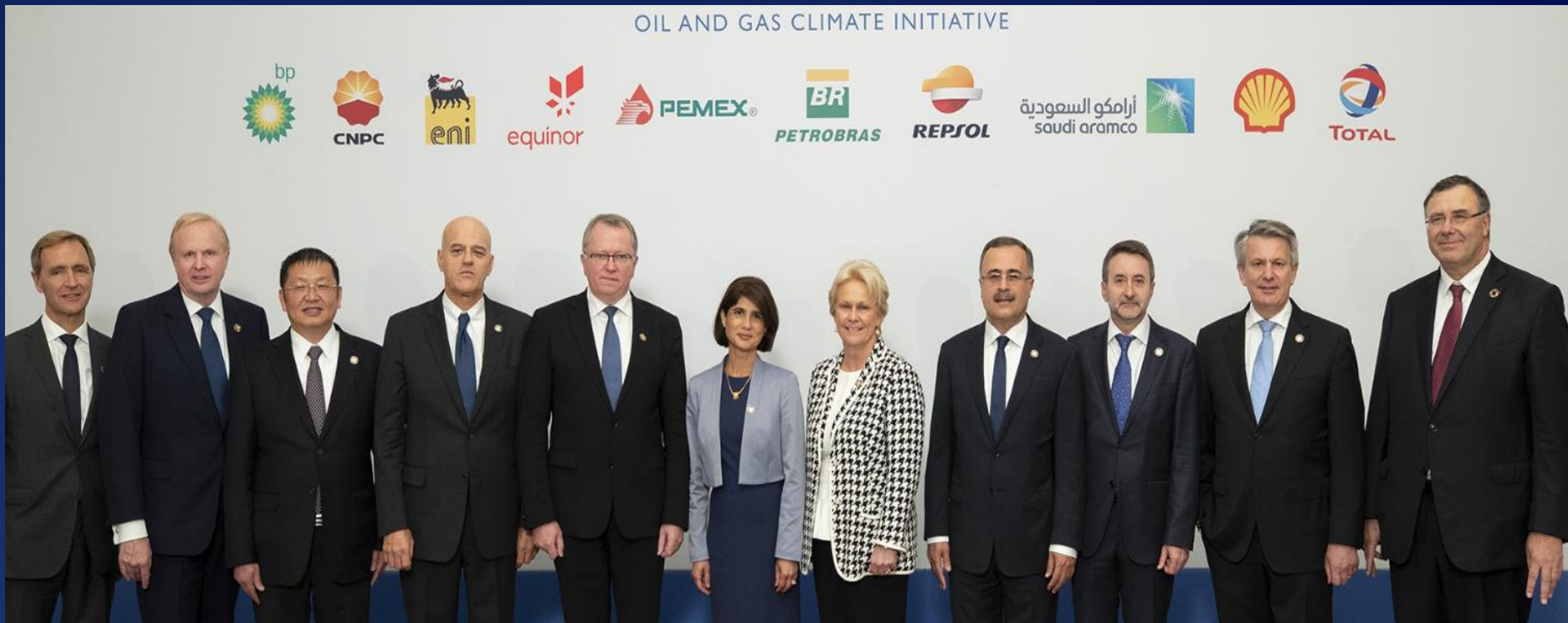


JPT: Sept 27, 2018

Oil and Gas Climate Initiative (OGCI)



- Voluntary, CEO-led initiative, established in 2014 by ten major oil/gas companies
- Aim: lower carbon footprints of energy industry via engagements, policies, investments and deployment



Public pressure matters (1)



- “Norway’s \$1 trillion pension fund wants out of oil stocks” (CNN, 4/16/18)
- “ExxonMobil to decrease CH₄ emissions by 15%, flaring by 25% by 2020. Already spent >\$9 billion since 2000, (O&GJ, 5/23/18)
- New target for CO₂ emission standards in the EU causing panic among car makers -- potential fines up to €33 billion (\$37 billion), (WSJ, 6/21/ 19)
- “Shell to link carbon emissions to executive pay, **capitulating** to investor pressure” (WSJ; 12/4/18)

Public pressure matters (2)

- California mandated completely carbon-free electricity by 2045 (WSJ, 9/17/18)
- Saudi Aramco to invest up to \$5 billion in the renewable energy sector (JPT; 7/18)
- 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)

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 CO_2 emissions; technically harder to clean than power generation

Why so hard to change? Economics!

- Macron imposed taxes on fuel to fight climate change; faced riots; had to backed 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; Gov. afraid of raising prices/taxes; fear of inciting riots



Quotable

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



— Bill Gates on tech innovation to battle greenhouse gas emissions

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, 2009

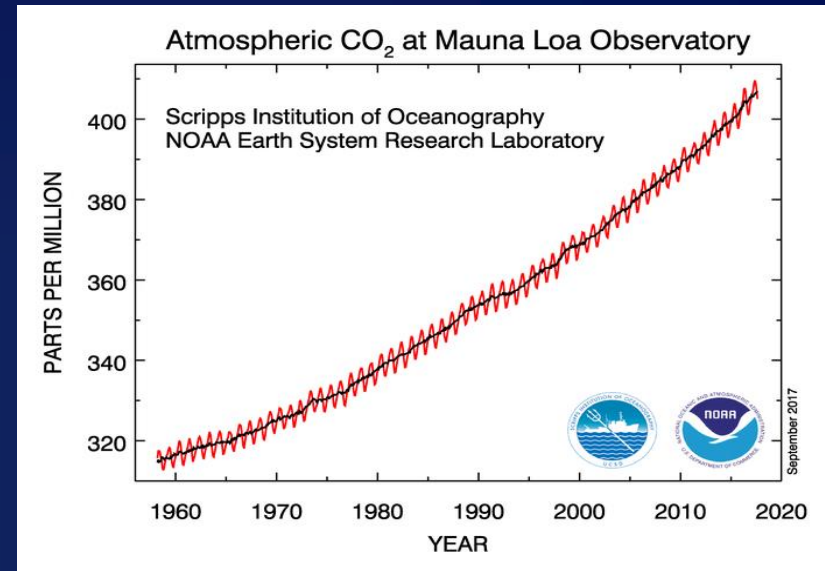
Methane, the hot gas...

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
- 21% more potent than CO₂; role of methane hydrates

My parting statement

- CO₂ sequestration will become an integral part of all operations utilizing fossil energy
- In fact, that process has already begun

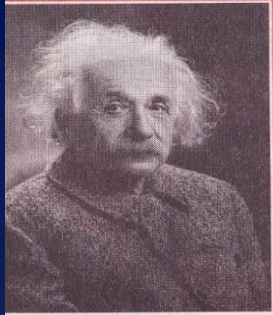




Green Transportation

Conclusions, Future Trends

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



**“ONCE YOU STOP LEARNING,
YOU START DYING.”**

So, take advantage of SPE's multiple learning opportunities – Albert Einstein

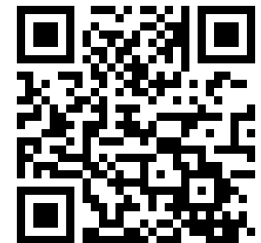
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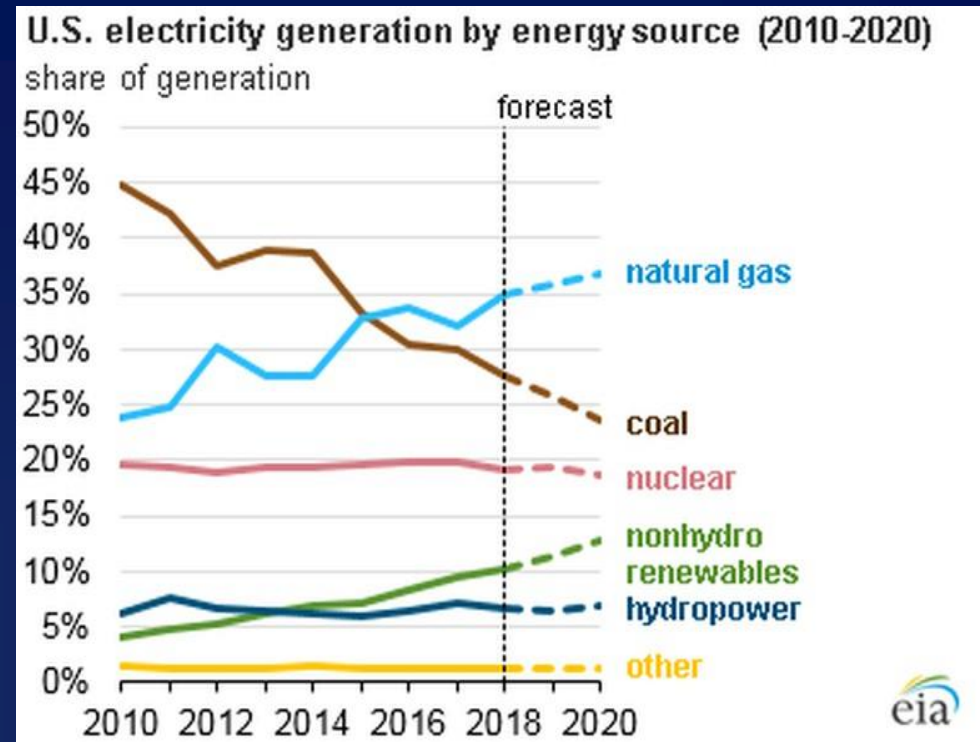
RESERVE

Current and future realities

- SPE's president called oil/gas industry at large to help meet the twin challenges of growing future energy demand and global climate change more aggressively — (2019 mtg of US Energy Association)
- “Considers SPE ideal with members in 154 countries — 65% under 35
- “We are ready to accept the responsibility as well as claim the credit”

Coal in trouble – gas is king

- Coal mines continue filing for bankruptcy
- Gas production surges
- Trend to continue
- Lower CO₂ emissions



- Renewable energy (wind, solar, hydro) to outpace coal by 2020 for first time ever in U.S.

“Sin stocks’ Seek Atonement”

(Wall Street Journal, 7/9/19)



- “Shell, VW, among those spending billions on ‘responsible’ products”
- “Across the spectrum of industries, companies act to improve their image/business prospects by shifting to less-harmful products”
- Ex.: VW, a pariah of investors (emissions scandal); focused on battery powered vehicles and hybrids
- Energy producers join hunt for ‘cleaner barrels’

Financial Times, 7/8/19)

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 moon and back) -- cost **\$170 billion** (2005 \$\$)

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

DOE laboratories, ExxonMobil launch lower-emissions research

- Two US DOE National Labs and ExxonMobil Corp. plan to invest up to \$100 million over 10 years to advance lower emissions energy technologies that could be brought to a commercial scale. One of the largest agreements between DOE's National Labs and the private sector
- Exxon's VP for R&D: "Finding solutions to address climate change is going to take everyone—governments, companies, and academia—working together,"



[Home](#) » [More General Interest](#) » [US Senate bill would boost carbon capture research](#)

[Consortium launches industrial-scale CCS project](#) | [Court blocks BC anti-Trans Mountain bill](#)

US Senate bill would boost carbon capture research

WASHINGTON, DC, May 28

05/28/2019

By Nick Snow

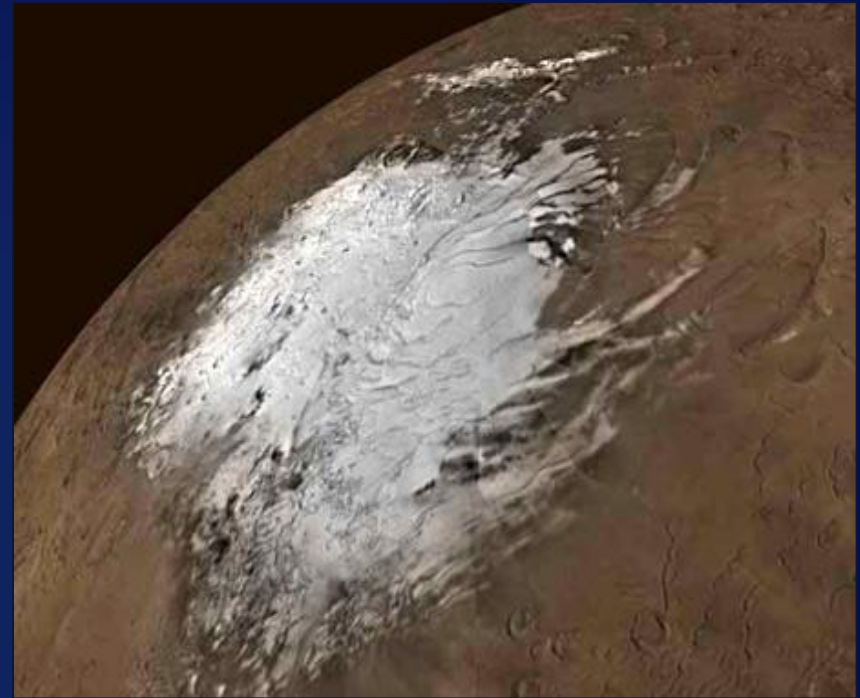
OGJ Washington Editor

US Sen. John Cornyn (R-Tex.) introduced legislation on May 23 that would require the US Department of Energy to establish a research, development, and demonstration program for carbon capture technologies at natural gas-fired power plants.

“The US leads the world in emissions reduction, but to build on that success, we need to incentivize innovation and partner with the private sector to create affordable solutions,” Cornyn said. “Instead of a one-size-fits-all mandate that would bankrupt our country, this bill encourages the continued use of natural gas so we can protect the environment and remain a global leader in energy innovation.”

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

- From NASA's Mars Global Surveyor and Odyssey missions
- CO₂ "ice caps" near Mars's south pole diminishing for three summers in a row



National Geographic, Feb 27, 2007

Vikings in warm Greenland

- Research by NW University, NSF Polar grant
- Warmer weather in Greenland 985 and 1450 (10°C)
- Oxygen isotopes, sediment bugs
- Vikings discovered America 500 years before Columbus did; abandoned it when it got cold





(Ryan Rodrick Beiler/Shutterstock)

German barn explosion caused by 90 farting cows

On the many dangers of methane gas

