



Outline Climate Change Nutshell: Climate change will be addressed with a multi-faceted strategy, or we will deeply regret not doing so For its part, the oil and gas industry will sequester CO₂, stop methane leaks and flaring, and <u>may</u> gradually transition to hydrogen Oil and gas companies that continue to embrace a "business-as-usual" approach will be absorbed by companies that embrace the new reality Renewables and Fossil Fuels Oil North Dakota























Reality Check: some sources of GHG emissions are hard to abate

- High temperature industrial processes: iron, steel, cement and chemical plants
- Long-distance transportation services, including heavy duty trucks, aviation, and marine

Oil Industry Responses to Climate Change

- Scope 1: direct emissions
- E.g., ExxonMobil announced that it will reduce GHG intensity 15-20% by 2025 by reducing methane leaks and gas flaring
- BP has pledged net zero by 2050
 - Invest in renewables
 - But to accomplish this requires some deception:
 - BP intends to sell off (not shut down) high GHG emitting assets!
 - BP conveniently exempts from its pledge its 19.75% stake in Rosneft, which is exploiting a massive \$134 bn Vostok oil project in the Arctic—estimated to contain 44 bn barrels of crude and to produce at a rate of 2 mn+ bpd
- Scope 2: emissions by contractors
- Scope 3: emission by customers

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Solutions:

- More Renewables
- More Nuclear (maybe Fusion)
- More efficiency
- Reduce fossil fuel demand
- CCUS
 - Carbon Tax/Cap & Trade
 - Carbon pricing for direct capture
- Solar radiation management
- All of the above and more





Solar Radiation Management through geoengineering:

- 1960s: floating billions of white "golf balls" in oceans to reflect sun (heat)
- 1991: Philippine Volcano Pinatubo spewed sulfates into the atmosphere, which led to .6°C cooling: Can science replicate this by launching reflector particles into the stratosphere or upper atmosphere?
- Other more contemporary ideas:
 - Pump ocean salt water into the air forming reflective water droplets
 - Pump salt water into low polar clouds to re-freeze the polar ice caps
 - Pump iron into oceans to stimulate algae growth to soak up CO₂
 - Pump smoke-stack emissions into stratosphere using stacks held in place by large balloons
 - Pump sulfuric acid into the stratosphere to offset global warming
- Danger: Unforeseen consequences
- Foes: Environmentalists who say "no" way too much





Nuclear

- We will need new, smaller, cookie-cutter nuclear plants
- Nuclear fusion may no longer be 20 years in the future—as it has been since the 1970s





































So what about the future: IEA WEO 2020

3 of 4 scenarios

- Stated Policies Scenario (STEPS—"business as usual"), in which Covid-19 is gradually brought under control in 2021 and the global economy quickly returns to pre-crisis levels
- Sustainable Development Scenario (SDS) assumes a surge in clean energy policies and investment to achieve sustainable energy objectives in full, including the Paris Agreement, energy access, and air quality goals, achieving net zero by 2070
- Net Zero Emissions by 2050 (NZE2050) addresses what outcomes would be needed to achieve net zero by 2050, instead of 2070







RethinkX (the game-changing outlook)

https://www.rethinkx.com/humanity

- "We are on the cusp of the fastest, deepest, most consequential transformation of human civilization in history...."
 - Food, transportation, energy, and associated materials costs fall by 10X+
 - Production processes are localized, become 10X more efficient, and consume 90% fewer natural resources
 - The world rapidly moves <u>from an extraction economy to a creation</u> <u>economy</u>, from scarcity to plenty, from inequitable and predatory competition to shared prosperity and collaboration
 - All within 10-15 years by market forces alone, absent government intervention to shore up traditional forms of food, transport, and energy



RethinkX

Transportation:

- TaaS (transportation as a service): Shared Autonomous eVs hailed on demand will rapidly replace individual car ownership and the ICE, be 10X cheaper for consumers, and far more efficient
- Fleets will be electrified, last for 500,000 to one million miles per e-V (compared to about 140,000 miles for an ICE vehicle) and on a per-mile basis, will 1/3 to 1/6 the cost of an ICE vehicle
- Autonomous e-vehicles, e-scooters, e-drones, and e-bikes will ease congestion







RethinkX

https://www.rethinkx.com/

- Specifically, what about oil?
- "We are on the verge of a major oil disruption...," like:
 - Oil saving the whale
 - Electric lights dooming oil
 - ICEs and autos saving oil
 - Automobiles dooming buggy whips!
 - Digital cameras dooming Polaroid and Kodak
 - Cellular phones dooming land-line phones
 - TaaS vehicles doom the oil and automotive industries?



- In 2019, <u>one</u> bitcoin transaction
 - Consumed energy equal to 28 gallons of gasoline
 - Consumed enough electricity (434 kwh) to power an average home for two weeks
 - 2/3 of electricity currently comes from fossil fuels
- In 2019, 390,000 bitcoin transactions occurred each day, consuming energy roughly equal to Switzerland's total energy consumption

For other outlooks, see appendix











Answers: CCUS and Solar Radiation Management (discussed above)





The battery wild card: Can we build a better battery?

- "The storage battery is, in my opinion, a catchpenny, a sensation, a mechanism for swindling the public by stock companies. The storage battery is one of those peculiar things which appeals to the imagination, and no more perfect thing could be desired by stock swindlers than that very selfsame thing. ... Just as soon as a man gets working on the secondary battery it brings out his latent capacity for lying." Thomas Edison
- Currently, in pure electric cars, batteries take up 80% more weight/space than gasoline







Other Wild Cards

- OPEC+
- Iranian oil
- Iraq oil
- Venezuelan oil
- Mexican oil
- All are hard to predict





Prosperity Formula/ Failure Formulas Paul Collier Nature + Technology + Regulation = **Prosperity** Nature + Technology – Regulation = **Plunder** Nature + Regulation – Technology = **Hunger**



Manag			Middle East Others					
Name	Country	0	0.2	0.4	0.6	0.8	1.0	1.
Norway Government Pension Fund Global	Norway							
China Investment Corporation	China							
Abu Dhabi Investment Authority	UAE							
Hong Kong Monetary Authority Investment Portfolio	Hong Kong							
Kuwait Investment Authority	Kuwait							
GIC Private Limited	Singapore							
SAFE Investment Company	China							
Temasek Holdings	Singapore							
Qatar Investment Authority	Qatar							
National Council for Social Security Fund	China							
Public Investment Fund	Saudi Arabia							
Investment Corporation of Dubai	UAE							
Mubadala Investment Company	UAE							
Turkey Wealth Fund	Turkey							
Korea Investment Corporation	South Korea							

Alberta Heritage Fund (HF) (the inspiration of Norway's fund)

- 1976: Established
- Early 1980s: The fund was used for capital expenditures for health, education, and research facilities
- 1987: Royalty transfers to the fund were stopped
 "Unfortunately, since 1985,...Alberta has behaved more like Venezuela than
 - Norway." Vincent Lauerman, Calgary, *Petroleum Economist*, April 2021
- 2003: Investment income from HF was dedicated to General Revenue Fund, flattening the Fund's rate of growth

 12/31/2020: HF was \$17.3 bn
- 2021: Alberta projects \$18.1 bn budget deficit and \$115.8 bn debt



The New "Super Cycle" to 2030+ High energy demand and trade, including oil and gas, means lots of transactions Governments, mineral owners, and investors Investor joint ventures Transportation, production sales, and financial arrangements Infrastructure construction Distribution contracts Buy/sell transactions, etc. + New technologies will require new legal solutions + Lots of disputes = Work for lawyers and landmen

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What are the most attractive oil investments for the next 10-15 years?

- Two places:
 - Offshore deep water, e.g., Brazil, GOM, West Africa—due to potential for huge discoveries and relatively low surface risk
 - Shale and tight oil, the Permian and Bakken—due to the presence of a known resource that can be tapped quickly to respond to high prices and delayed to respond to low prices
 - But shale and tight oil make for a volatile roller coaster ride
 - Thus, states should tax oil resources progressively and invest, not spend

















What is missing?

- ExxonMobil's Energy Outlook
- It should have come out last fall
- Are experts at XOM having a problem reaching a consensus?