CLIMATE CHANGE

EXPLAINED

By
Dr Ian Dexter Palmer

WHAT IS FRACKING?

So...
What is a fracking operation (also called a frac job)?

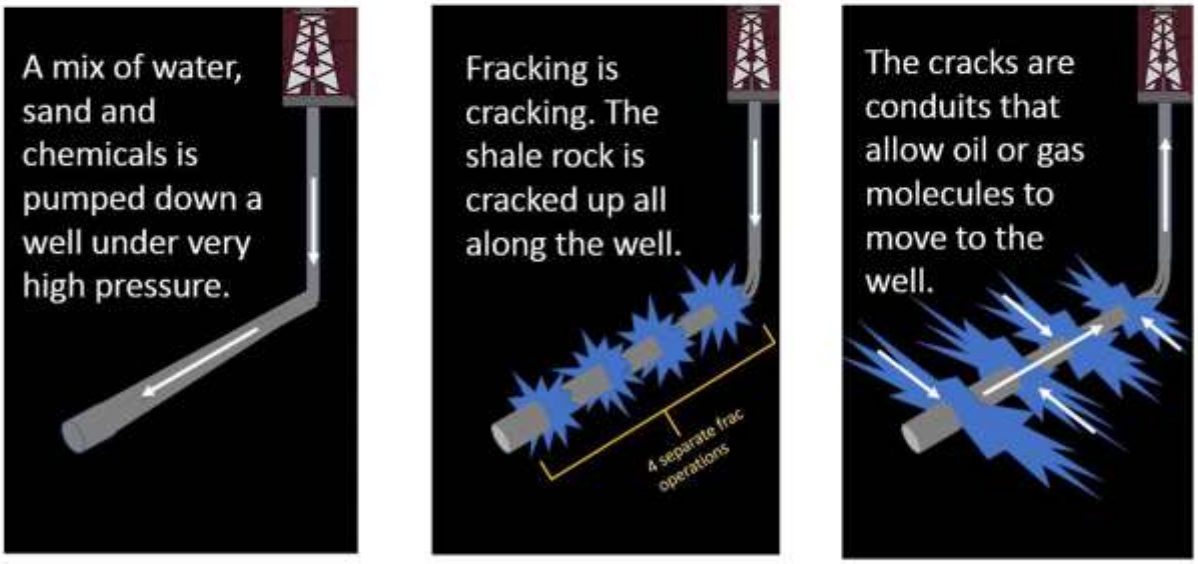


Illustration by Ian Dexter Palmer

Massive frac-pumping equipment, water tanks, and proppant-sand boxes in place and ready for a new-technology shale-fracking operation.

How much water used to frac new-technology wells?

40 separate fracs along a horizontal well that is 2 miles long.

Total frac water injected about **20 million gallons**.

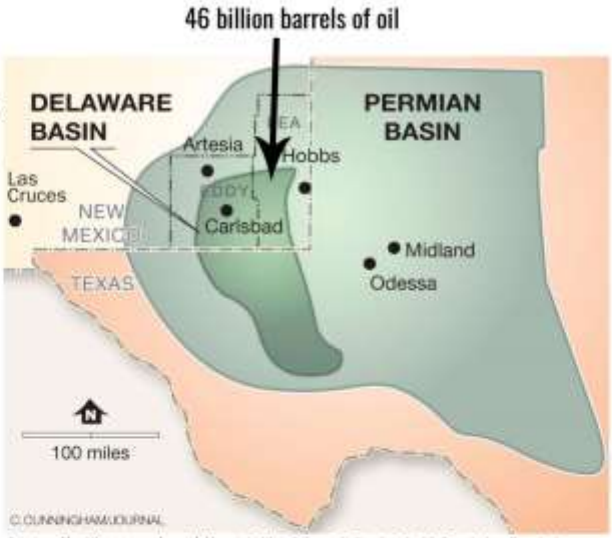
Enough to cover the grass in a football stadium **to height of 40 feet.**

BUT the total volume of frac water used in New Mexico (and Pennsylvania) is less than 1% of water budget.

Water used to be fresh water – now produced water is being cleaned up for next frac job.

WHY IS THE DELAWARE BASIN IMPORTANT?

Wolfcamp and Bone Spring formations sit at different layers within the Delaware Basin.



Courtesy The Albuquerque Journal, Mountain View Telegraph. Reprinted with Permission. Permission does not imply endorsement

MEANWHILE...

Southeast New Mexico and West Texas are sitting on a ocean of oil and gas in the Delaware Basin.

Two underground layers together contain 46 billion barrels of oil, 280 trillion cubic feet of natural gas, and 20 billion barrels of natural gas liquids (NGLs).

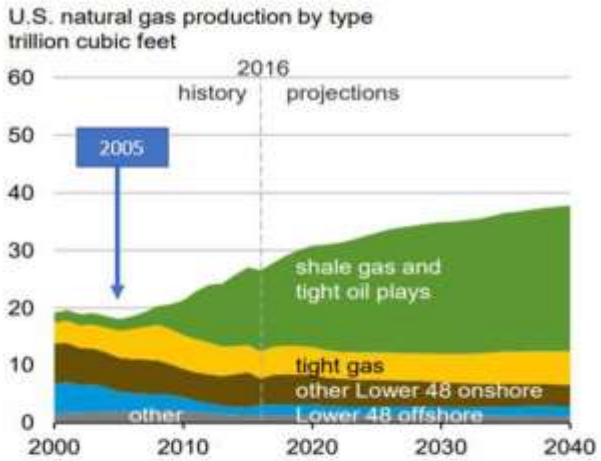
The immense quantities of oil in the Delaware basin are the largest "pool" of oil and gas ever found anywhere in the USA.

The oil boom in southeast New Mexico has generated $1.2 billion in surplus, meaning new money available for state spending in the next fiscal year budget.

New Mexico will likely benefit from high levels of oil production, and budget surpluses, for many years to come.

HOW BIG IS SHALE-OIL & SHALE-GAS?

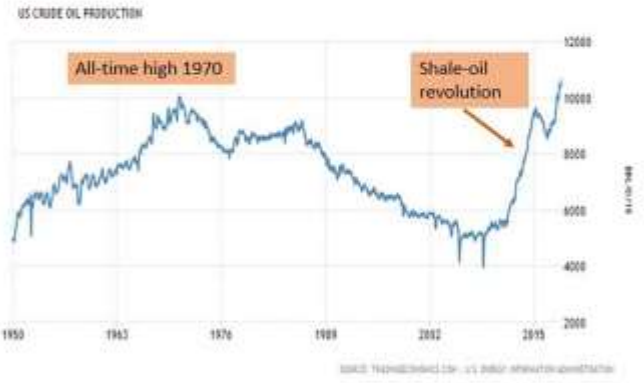
SHALE REVOLUTION IN THE USA



Source: EIA Annual Energy Outlook 2017

Natural gas in the USA was on the decline until 2005 – when shale-gas took off.

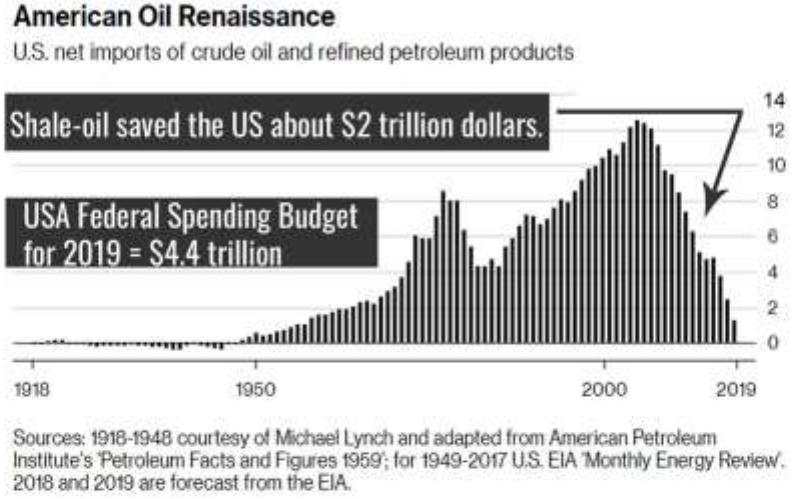
Shale-oil took off after 2010 and total US crude oil reached 11 million barrels per day (MMbpd).



The previous all-time high was 10 MMbpd in 1970, after Alaska came onstream.

In 2018, the US surpassed both Saudi Arabia and Russia

IS THE USA SELF-SUFFICIENT IN OIL & GAS?



US net imports of crude oil and refined products (gasoline and diesel).
The scale on the right is in millions of barrels per day (MMbpd).

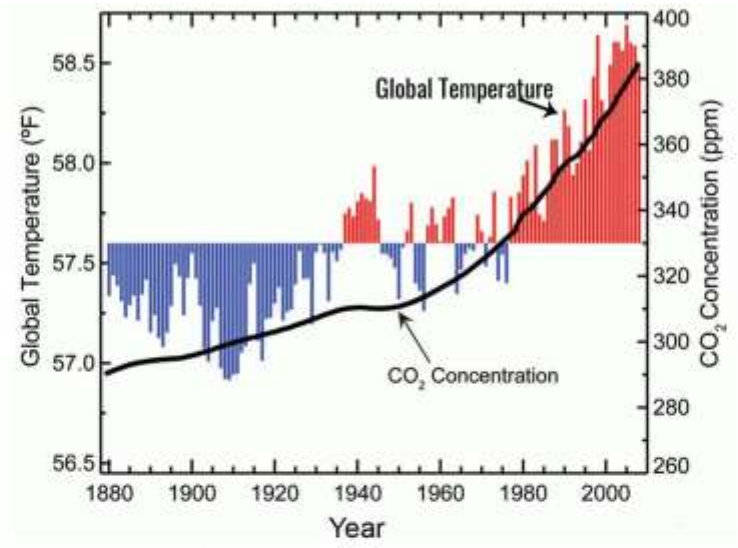
The US is now exporting crude oil – about 3 MMbpd in late 2018 -- while it is importing about as much at the same time.

Imports of heavy sour crude to match domestic refineries. Exports of light sweet crude that doesn't match – e.g. crude oil from the Permian basin.

USA became a net exporter of crude oil in 2019. The first time since 1947 that the USA has been self-sufficient.

Javier Blas, "The U.S. Just Became a Net Oil Exporter for the First Time in 75 Years." Bloomberg, 6 December 2018.

IS GLOBAL WARMING REAL?



Source: NOAA/NCDC

Greenhouse gases (GHG) such as CO2 are the driver of global warming.

If we don't control GHG emissions, models predict by 2100 earth's temperature will be hotter than in the past million years

The concentration of CO2 in the atmosphere is already higher than its been in 3 million years.

EARTH IN THE TWILIGHT ZONE.

IS CLIMATE CHANGE REAL?

Physical Indications

Glaciers retreating. √
Arctic ice melting. √
Corals bleaching. √

Extreme Climate Events

Droughts. ?
Wildfires. ?
Tropical storms. ?
Hurricanes. ?

"AUSTRALIA: BUSHFIRE"

*Destroyed thousands of buildings,
*Killed more than a billion wild animals
*Caused at least 34 deaths.
*Insured losses were estimated at S3.6 billion, although other estimates have put the total costs as high as AUS S100 billion (US S70 billion).

Most expensive extreme weather events in 2020 - worldwide

1. Australia bushfires (Australia, S5 billion)
2. Locust swarms (East Africa, S8.5 billion)
3. Windstorms Ciara and Alex (Europe, S5.9 billion)
4. Cyclone Amphan (India, Sri Lanka, Bangladesh, S13 billion)
5. Atlantic Hurricane season (US, Central America, S40 billion)
6. China floods (China, S32 billion)
7. India floods (India, S10 billion)
8. Kyushu floods (Japan, S5 billion)
9. Pakistan floods (Pakistan, S1.5 billion)
10. US West Coast fires (US, S20 billion)

WHAT IS THE LINK BETWEEN SHALE & CLIMATE CHANGE?

Its not just shale, its oil and gas produced all over the world.
Shale oil is 7 million barrels per day.
World total is 90 million barrels per day.
Shale is a "proxy" for world oil.

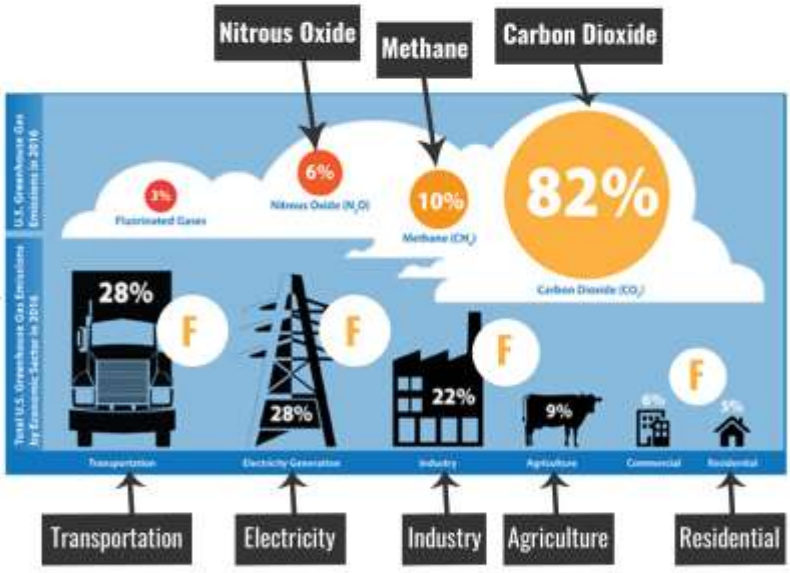
In the USA, 75% of greenhouse gas emissions are due to burning of fossil fuels: coal, oil, natural gas.

USA: GHG EMISSION

USA greenhouse gas emissions in 2016, by gas type.

USA greenhouse gas emissions by economic sector in 2016.

Most of GHG emissions come from fossil fuels (F = 75%)



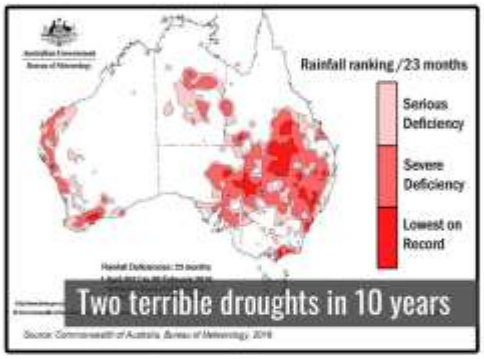
Source: Greenhouse Gas Inventory Data Explorer," US Environmental Protection Agency

HOW URGENTLY DO WE NEED TO REDUCE GREENHOUSE GAS EMISSIONS?

By 2030... environmentalists.

By 2050... oil and gas companies

We need to move toward a carbon-free future, but how long will it take?
Does an extra 20 years matter?



Two terrible droughts in 10 years


Bahamas destroyed by hurricane

The Biden administration goals for the USA

Double wind capacity by 2030.

Carbon-free electricity by 2035

Net-zero greenhouse gas emissions by 2050


Town of Paradise, Ca, destroyed by wildfire

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A GLIDE PATH IS NEEDED FOR OIL & GAS COMPANIES

Landing Rules

Burning fossil fuels cause 75% of greenhouse gas emissions.

Oil and gas will still be significant by 2050 - perhaps 30-50% of energy consumption.

The most practical timescale for the transition is a goal of net-zero greenhouse gas emissions by 2050. Not actual zero, but net zero.

Jobs need to be preserved, e.g. workers retrained in the transition.

This is not a glide path

The UN said that to reach the Paris Agreement target of keeping global warming to 1.5°C ...

The world needs to reduce fossil fuel production by 6% a year between 2020 and 2030.

It warns that currently countries are planning an annual increase of 2%.

From UN 'Production Gap' report (Nov 2020)

THE GLIDE-PATH TO NET-ZERO BY 2050

EASY - Green power for all oil/gas operations: drilling wells or fracking.

HARD - Reduce to near zero flaring of gas and leaking of methane from wells, pipelines, and facilities

CHALLENGING - Redirect some investments into renewable energies. BP will be invested 40% in renewables by 2030; Total are investing $2.5 billion in solar with Adani Green Energy

GLIDE PATH IN DENMARK

100,000 barrels per day in North Sea.

As of 2020 stopped exploring for oil.

Will stop producing oil by 2050.

Will shift lost jobs into (1) offshore wind farms, (2) carbon capture and storage.

THE RUSH TO RENEWABLES

You must have a backup: Either big batteries or gas-burning power plants

Texas

Texas produces the most oil and gas of any state in the USA. **If Texas were a country, it would be the sixth largest oil and gas producer in the world.**

Texas is by far the No. 1 producer of wind energy in the United States. **If it were its own country, Texas would be the fourth-largest wind-producing country in the world (2017 data).**

One of the fastest-growing jobs in the US is wind turbine technician. The salaries are good: median pay in 2019 was $53,000.

The income derived from leasing a single turbine varies. Up to $8,000 per turbine per year.

A red-state, conservative guy called Rick Perry from oil country helped build in Texas one of the biggest renewable energy systems in the world.

SOUTH AUSTRALIA

South Australia was at 41% renewable electricity in 2016 and aiming for 50% by 2025.

Hornsdale big-battery. Source: David Box

A storm slashed its way across the state, downing 20 transmission towers in the grid. Wind turbines had to be turned off. To protect the rest of the grid, automatic pilots shut down the rest of the state. The entire state blacked out at 4 pm on a weekday. And this lasted all evening!

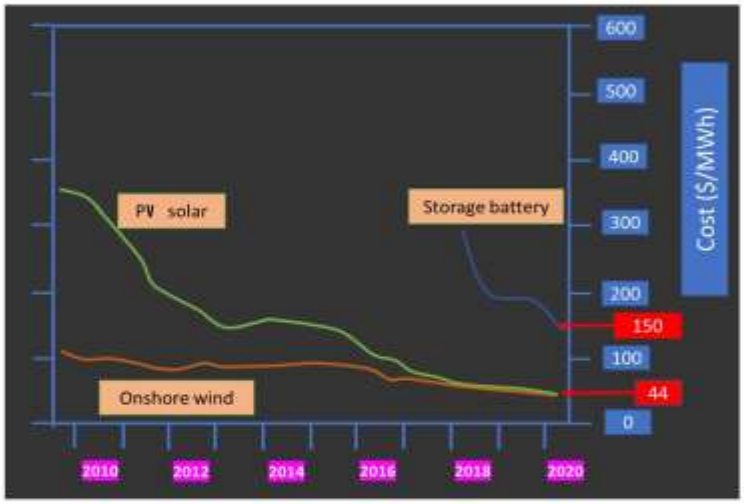
Need backup to avoid blackouts: Big-Batteries

South Australia....Tesla big-battery 100 MW built 2017 – now upgraded to 150 MW

Victoria....Tesla mega-battery 300 MW to be built in 2021

Gransolar says 13 big-batteries will be up and running by the middle of 2022, concentrated mostly in Victoria and South Australia.

COSTS OF WIND AND SOLAR AND BATTERIES HAVE FALLEN A LOT



Storage battery costs have halved in past 2 years.

Can replace coal-fired power plants by renewables.

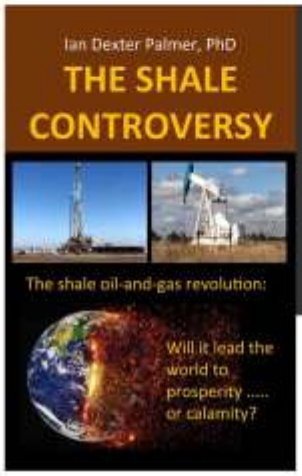
Don't need natural gas as "halfway house".

Source: Renew Economy

Latest CSIRO GenCost report shows wind and solar still easily cheapest electricity generation - even when storage and network costs added for 90% renewable grid

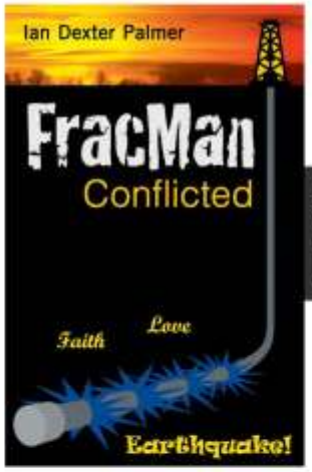
Books by Ian Dexter Palmer

Books on Fracking



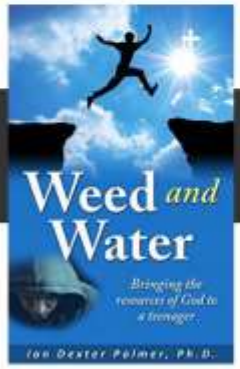
The facts about fracking: non fiction

"Dr Palmer took a complex topic and presented his material in layman terms for a general audience, even adding suggested topics and chapters for those not inclined to read this book from beginning to end." - New Mexico Press



A novel of decisions, risks, love, and faith set in the fracking industry. (Fiction)

Other titles



Fiction

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