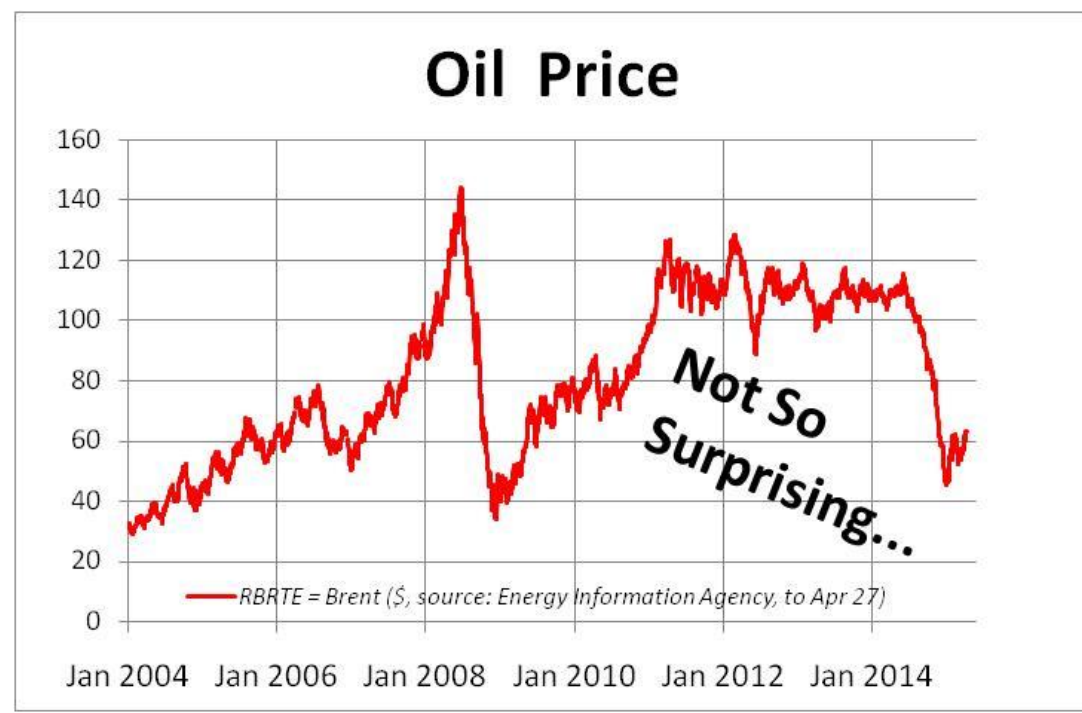


Petroleum, Energy, Uncertainty: Navigating the Crossroads Ahead

Industry View: Rosy Glasses?

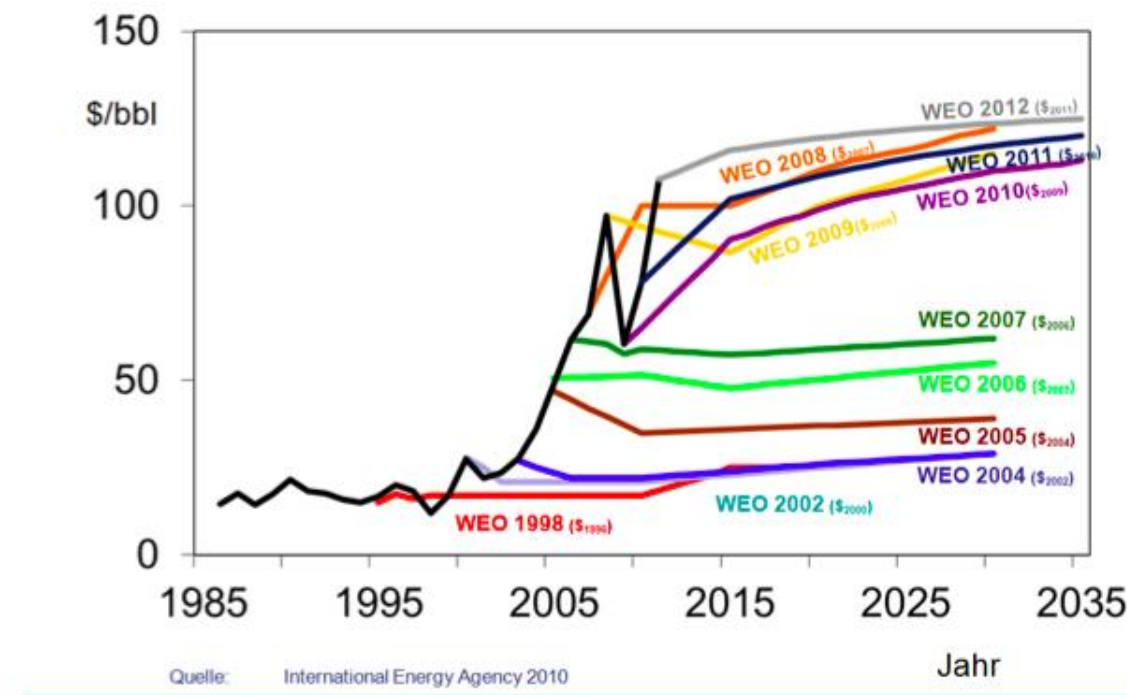
Oil Price Drop Is No Surprise.



Irregularities are often seen as a thing of the past rather than a daily possibility so the recent oil price drop surprises. Forecasters tend to assume stability, and rarely look back. The much

used IEA forecast below, showing price and forecast, shows its practical value is limited.

Ölpreisprognosen der IEA World Energy Outlooks (WEO) 1998 bis 2012



Simple time bracketing, looking 10 years back for a 10 year project, would clarify matters. Yet the Petroleum Industry chooses surprise, staff cuts, government support, to be followed by skill shortages once the price recovers.

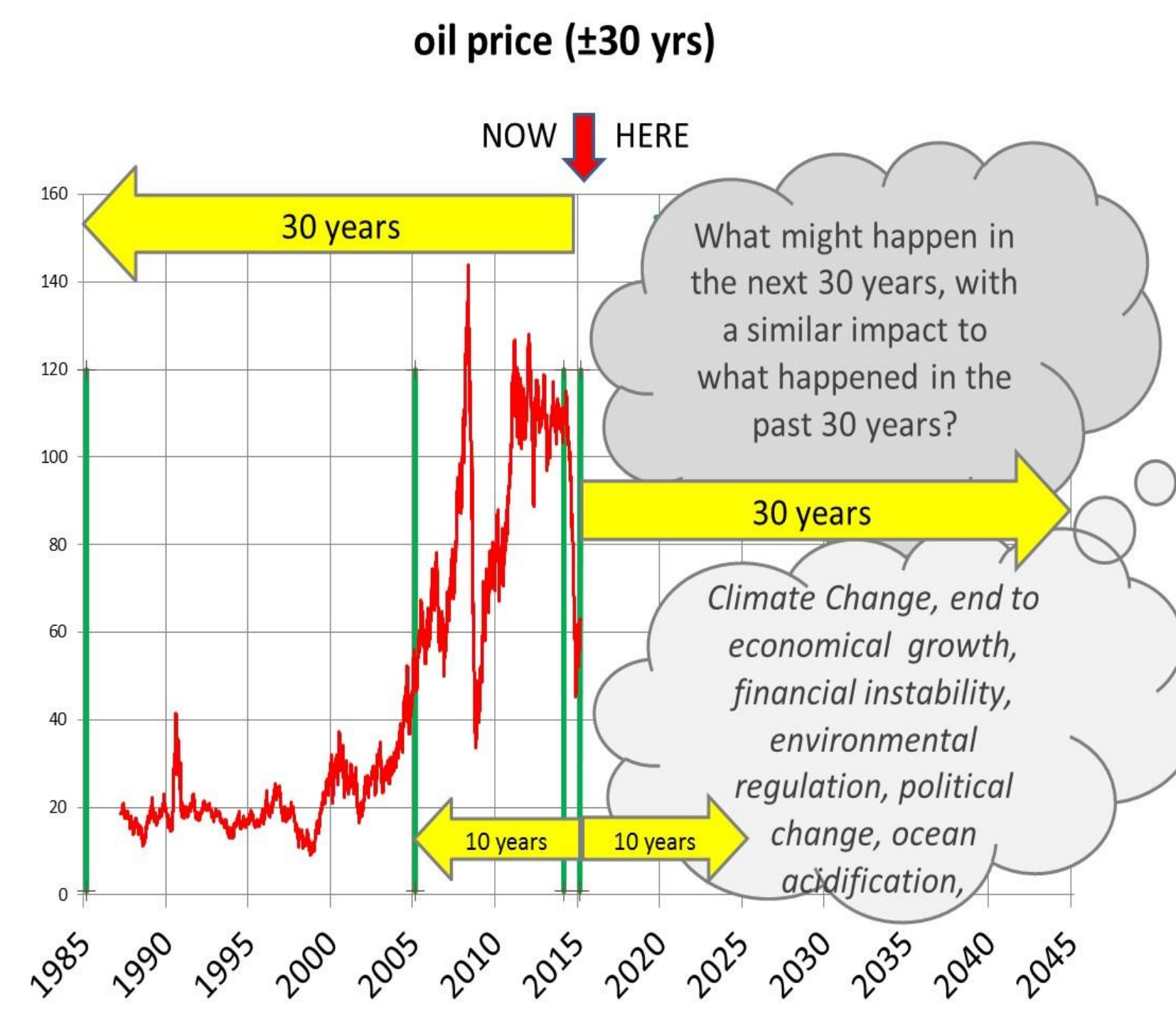
In the short term oil price is volatile, depending mainly on demand, speculation, and lesser extent supply. In the longer term it depends more on supply, marginal cost of supply, and cost of alternatives in approximate order of importance.

It is important to choose the industry, oil or energy, diligently because the long term price is important for project payback.

A Wider View: Big Challenges

Big Changes In The Coming 30 Years

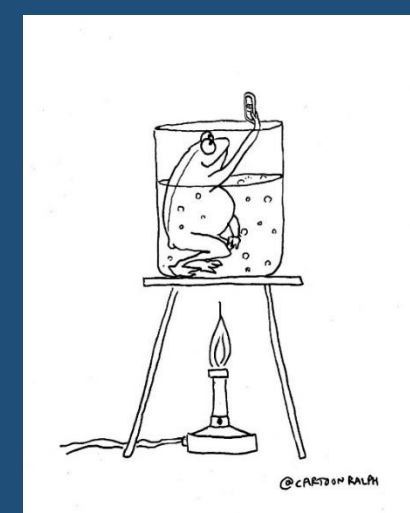
To look ahead 30 years, we first look back 30 years to sample uncertainty and volatility. This shows a lot happens in 30 years.



Looking back holds no answers, but is a range indicator we commonly use in technical work.

But looking back is no excuse for not looking ahead and around. Large changes are already entering the energy world. The major influences are: political response, demand for energy, and cost and availability of alternatives sources.

Some possible pressures on price/demand: Climate Change response (↓/↓), end to economic growth (↓/↓), Financial market instability (↓/↓) or collapse (↓/↓), environmental regulations (↓/↓), political upheaval (↓/↓), wars (↑/↓), ...



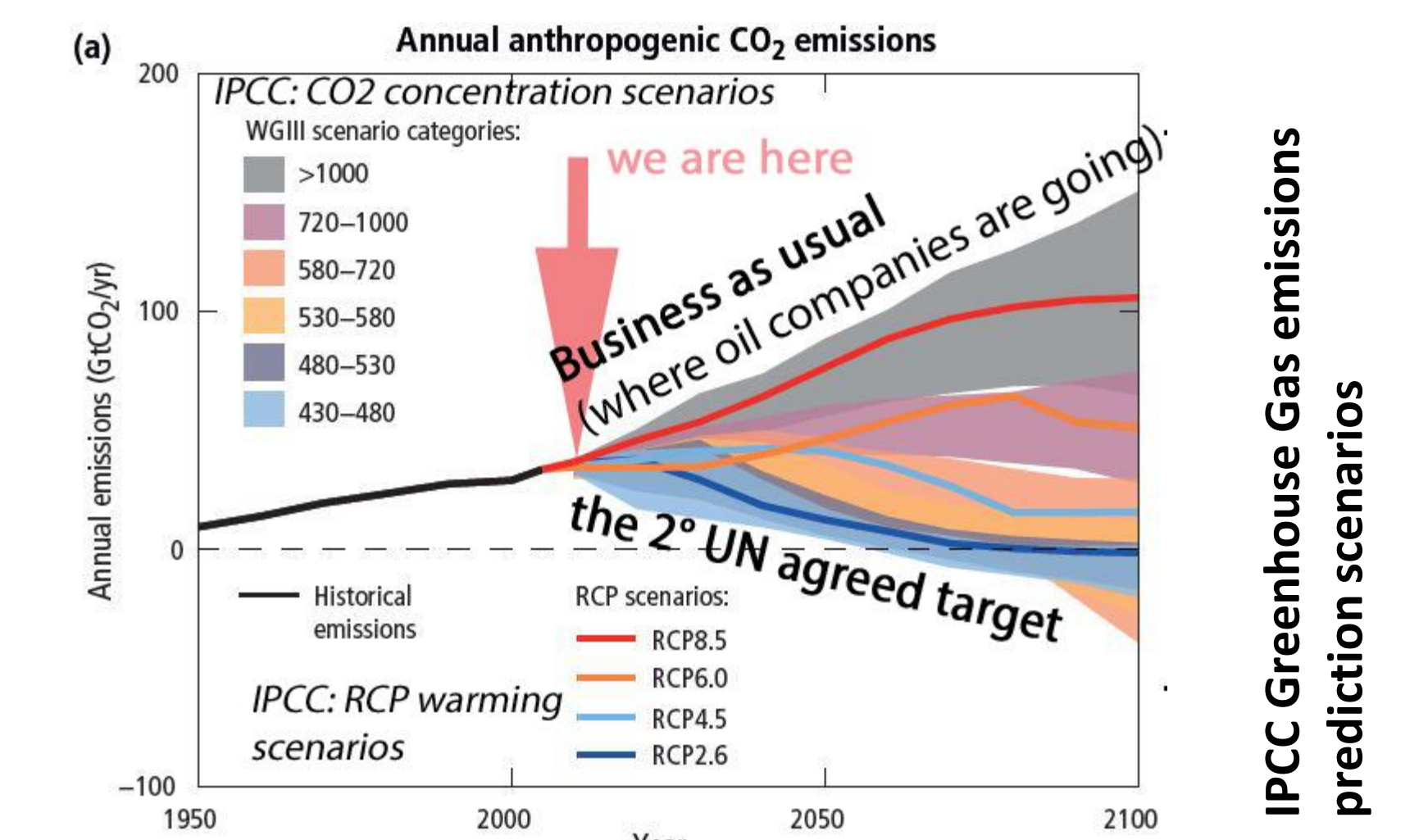
Slow change is easy to miss. It is worth taking a step back to see the big picture...

Industry Challenges & Choices

Diverging Pathways: Oil vs. Energy

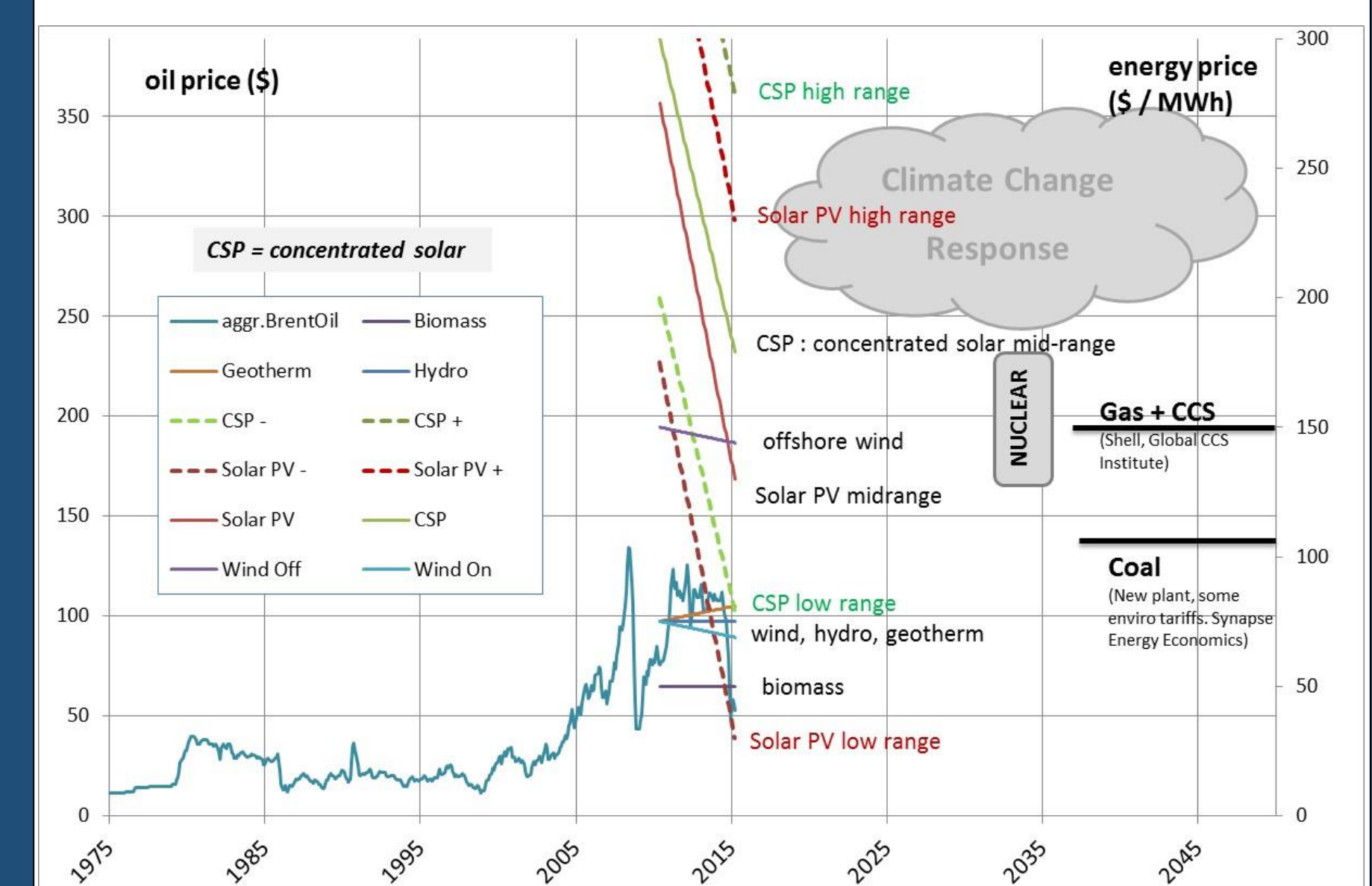
In the immediate future customers will reduce CO₂ emissions to prevent escalation. They will first switch to lower carbon: coal to oil to gas, perhaps nuclear, and all renewables available, and then onwards to "zero" carbon: renewables or perhaps temporarily to hydrocarbon with CCS if available.

Whether this change occurs by a carbon tariff, global agreements, revolutions, politics, regulations, or cost and energy security considerations is trivial: we should expect demand for our product to change soon.



Threatened Position In Energy Market

To see where other energy sources compare, we converted oil price to energy cost and added recent data (2012, 2014) of "energy competitors". This creates a sobering picture.

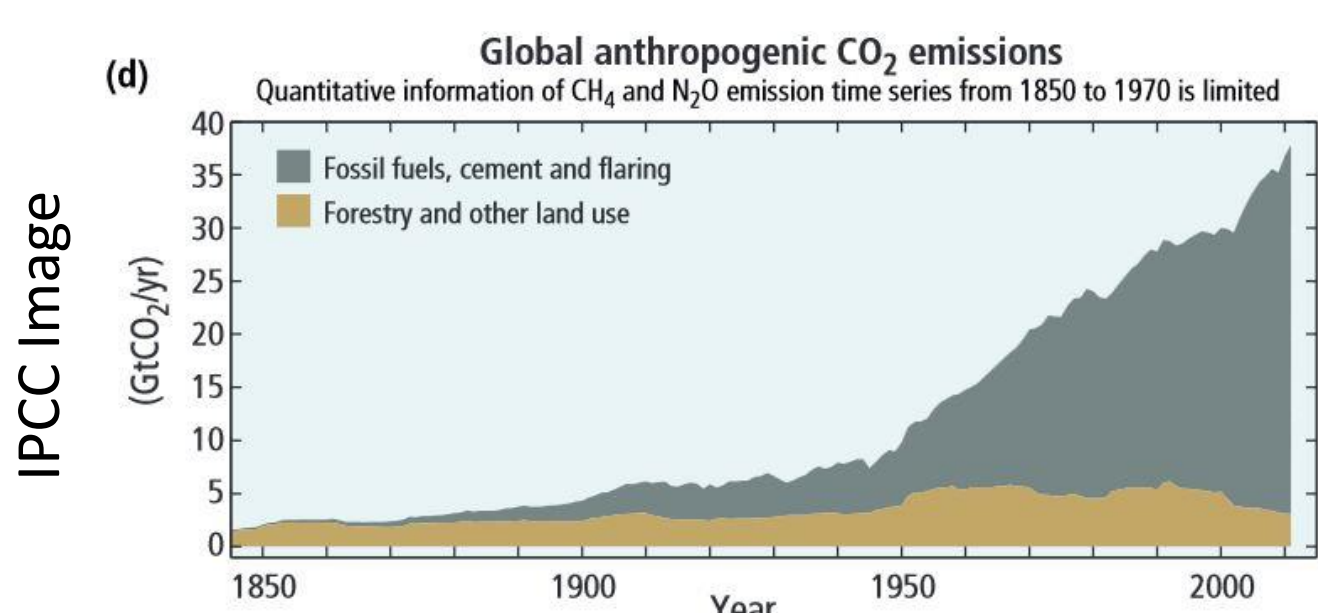


On a cost equivalent basis we see our non-carbon competitors either already in the carbon fuel price range or getting there, with only offshore wind still lagging. Nuclear is also estimated.

So oil is still cheaper than many alternatives, but only for a few years more.

Climate Change: An Imminent Threat To More Than The Petroleum Industry

Governments and industry agree that Climate Change is a colossal threat, and escalation needs to be prevented. The main cause is greenhouse gas emission: 65% by CO₂ from fossil fuel and industrial processes, 16% by Methane mainly from carbon energy industry.



The United Nations have agreed to try to stay below 2°C rise in average global temperature to prevent catastrophe; we're at 0.8°C going to 1.6°C (locked in).

To achieve this global cumulative carbon emissions must stay below ~500 GT from now.

At our current emissions rate we reach this within 15 years: well within project horizons.

Global consequences of exceeding the 2°C rise are likely catastrophic. Ice cap and tundra melt causing warming lock-in, sea level rise ~2m this century to ~17m total, ocean acidification causing marine food chain collapse, more extreme weather events, floods and droughts causing global food and water shortages, infrastructure damage. Economic collapse, population displacements and social upheaval. Disintegration of our societies.

Future Scenarios: Industry View Conflicts With Most Others

Similarities abound between the views of Shell, Exxon and BP, all producers of "outlooks" or "scenarios" popular with the industry.

All three assume the 2°C warming scenario will be exceeded. Continued energy consumption growth will prevail, that is positive, and increasing oil, gas, coal usage is the only way to achieve this.

They suggest renewable energy is not sufficiently available in time.

They take Climate Change seriously, but a recent focus on "affordable energy for the common good" does not specify whether a damaged earth and destroyed civilisation is an "affordable" price.

Being experts in fluid carbon energy, carbon holds their answer.

If your only tool is a hammer, many problems look like nails.

Other substantial global organisations including the UN have a different view.

Detailed blueprints describing **how to achieve** the 2°C scenario are available from organisations including the UN, the IEA, the EU, the WWF, Greenpeace, Friends of the Earth, IRENA, and even the UK and US Governments. Technical issues are managed, new solutions found daily. The only thing delaying implementation is popular support.

They take climate change seriously, and so work with experts in low and non-carbon energy.

They approach it like the petroleum industry managed deep water: understand the problem, then find or make the tools to resolve it. The tools are available now.

Pathways For The Industry

Ignore

Requires: Business as usual, pursue weaker regulations and taxation, issue biased information. Pursue CCS if financially expedient. Result: Remain part of the problem. Single-product instability, staff volatility and growing public antipathy. Companies progressively fail, possibly after irreversible damage has been done.

All Out CCS

Requires: Drive investment in CCS (Carbon Capture and Sequestration) for large scale implementation; do not wait for subsidies. Move asset base to gas, to reduce total capacity requirement. Share knowledge, sell technology. Result: This may buy time for a real solution; if done late or slowly it may delay a real solution. It may help respect the 2°C limit, and also assist future full decarbonisation. It may not work as intended.

Diversify

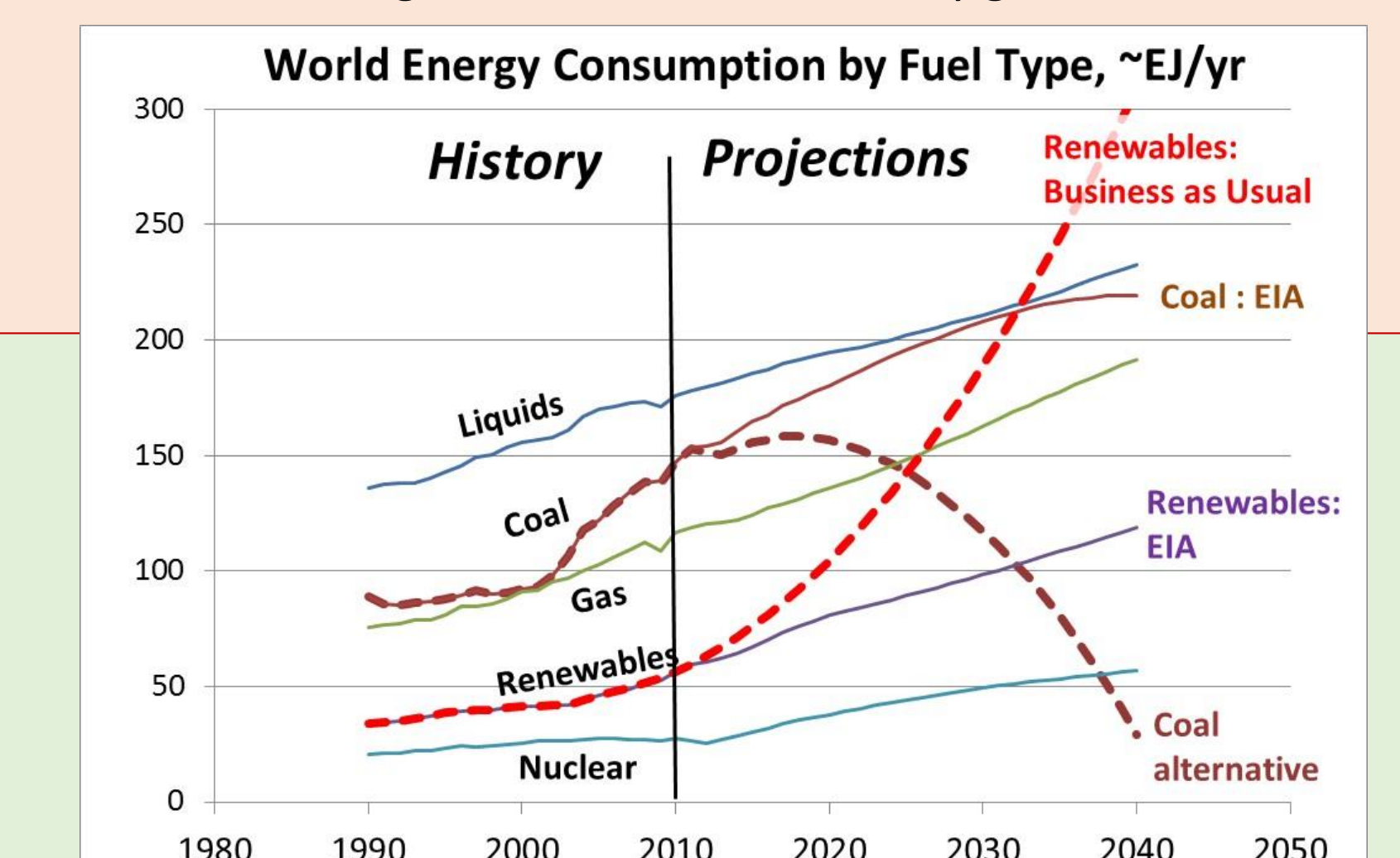
Requires: Become integrated energy companies. Invest in energy technology, distribution, generation, efficiency, and decarbonisation companies and research. Combine skills and cross-fertilise. Over 30 years phase out hydrocarbon while expanding alternatives, with stable staff and skills management. Verify whether CCS is a valid tool to assist.

Result: Become a true global contributor in a less cyclic business environment. Better staff supply, skills, morale at reduced cost. Interesting challenges and more opportunities. Help achieve the UN 2°C scenario, an ethical choice.

Are Competing Energy Sources Available Soon Enough?

Most knowledgeable estimates say they are, others doubt.

The EIA (US Energy Information Administration) makes regular projections on energy consumption by source: the figure shows their 2013 view: actuals to 2010 and projections onwards. Renewables are shown growing at the same pace as other energy sources, highlighting oil industry bias: in reality the renewables growth rate is substantially greater.



Using the same raw data but a strictly mathematical approach, basing the renewables trend on 5 years data up to 2010, the dotted line shows the **business as usual** result, a more realistic image. This has since been substantially exceeded. For the illustration coal was adjusted to keep energy totals constant. Precedents abound of dramatic change given the incentives.

References, Affiliations, Author

References and additional detail may be downloaded at: AberdeenClimateAction.org/Devex2015.html

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