

Global Influences on Future E&P Demand

And Likely Future Outcomes

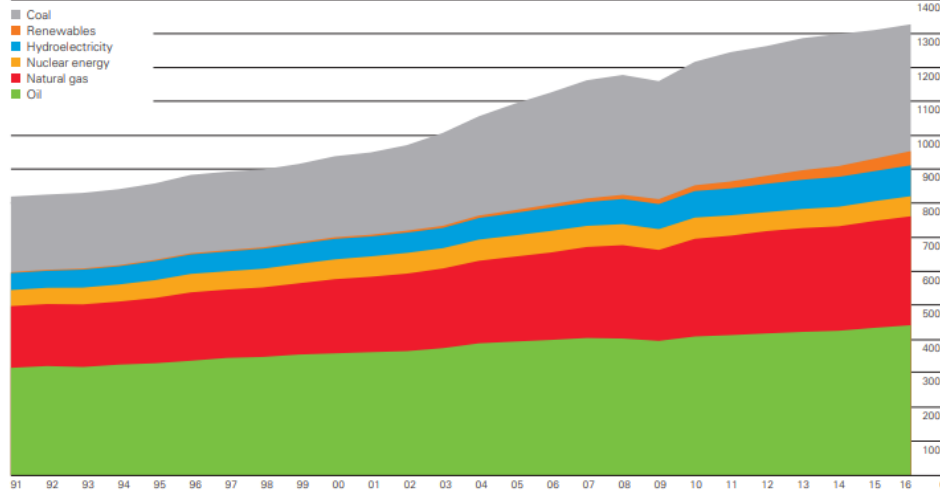


Are we a Dinosaur Industry?

- Would you recommend a career in the hydrocarbon industry to your children?
 - What does world hydrocarbon consumption look like today?
 - Are we seeing a significant change in the driving forces for the world energy balance as distinct from the usual geopolitical perturbations.
 - The shale revolution
 - Are we replacing reserves for the future - do we need to?
 - Hydrocarbons as a finite resource – are we using them appropriately
 - Renewables and lifecycle.
 - People and Attitudes
 - The Future

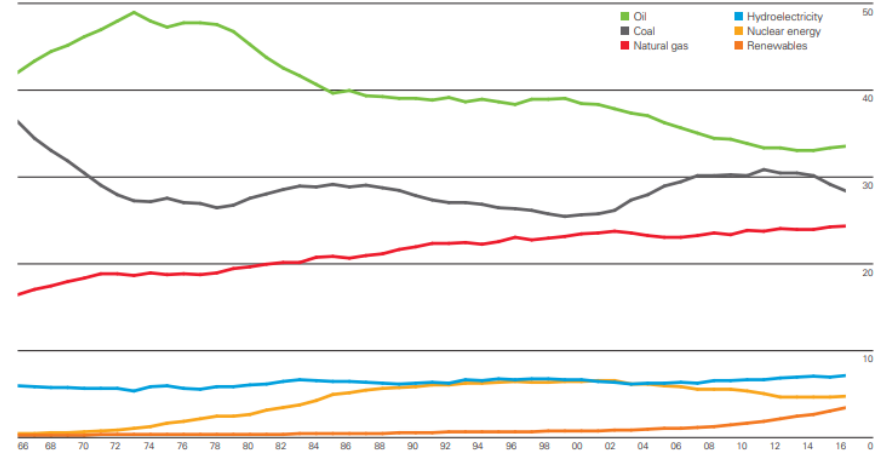
Consumption

World consumption
Million tonnes oil equivalent



World primary energy consumption grew by 1.0% in 2016, well below the 10-year average of 1.8% and the third consecutive year at or below 1%. As was the case in 2015, growth was below average in all regions except Europe & Eurasia. All fuels except oil and nuclear power grew at below-average rates. Oil provided the largest increment to energy consumption at 77 million tonnes of oil equivalent (mtoe), followed by natural gas (57 mtoe) and renewable power (53 mtoe).

Shares of global primary energy consumption
Percentage



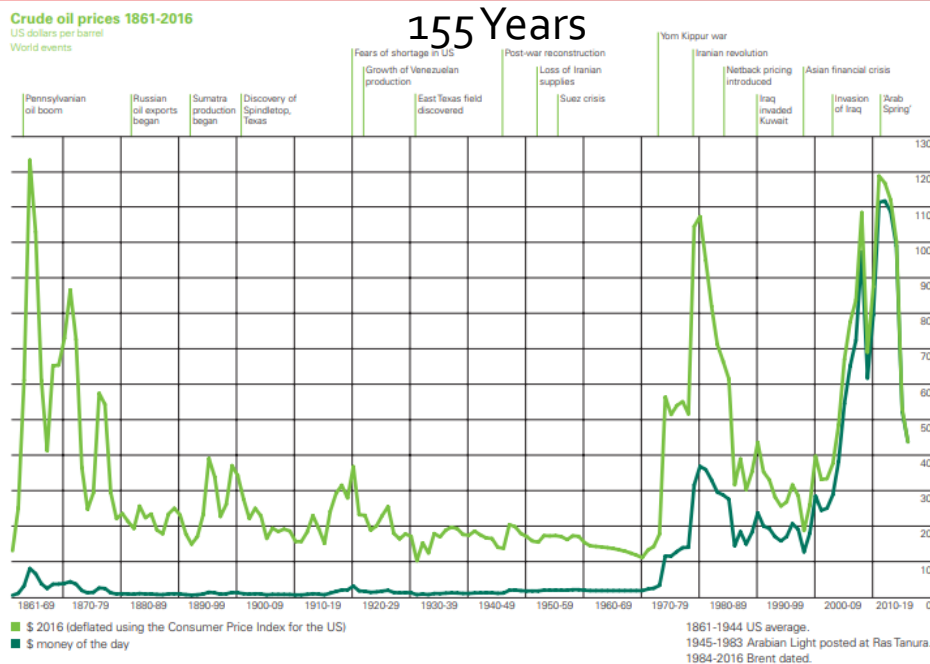
Oil remains the world's dominant fuel, making up roughly a third of all energy consumed. In 2016 oil gained global market share for the second year in a row, following 15 years of declines from 1999 to 2014. Coal's market share fell to 28.1%, the lowest level since 2004. Renewables in power generation accounted for a record 3.2% of global primary energy consumption.

- Oil remains the world's dominant fuel making roughly a third of all energy consumed in 2016, this follows 15 years of decline from 1999 – 2014
- Natural gas accounts for 25% of the world's energy consumption
- Coal's market share has fallen by 28% and is at the lowest level since 2004
- Renewables in power generation accounts for 3.2% of global primary energy consumption.
- Growth in developing economies continues to drive energy demand but the global energy mix is changing and becoming more diverse.

Price as a Proxy for Hydrocarbon Usage and Market Sentiment.

Crude oil prices 1861-2016

US dollars per barrel
World events



5 Years

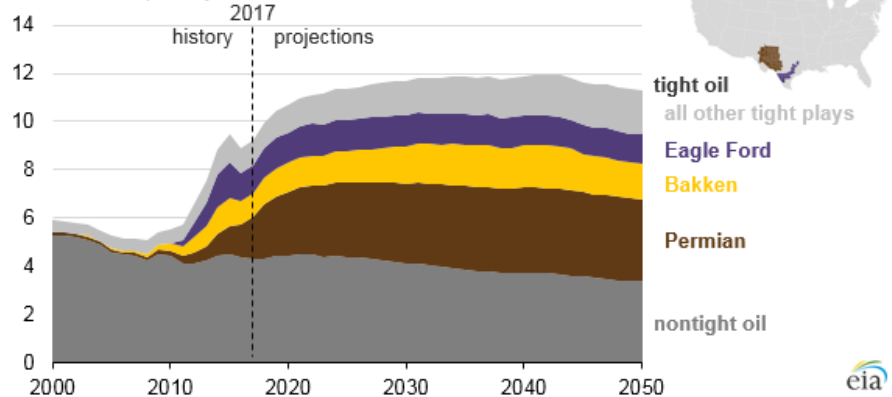


- Changes in geopolitics over the last 100 years have been the major driver for significant changes in the oil price.
- Predominantly wars and regime changes, the most recent of these being the Iraq wars and fears arising from the Arab spring.
- However since 2010 we have seen a drastic decline in the oil price with no real changes in the geopolitics.
- This has been attributed to a many causes including but not exclusively the development and oversupply resulting from the shale oil revolution, increased energy awareness and efficiencies, and the global commitment to move to renewables.
- However OPEC decisions and actions have dominated the oil price since 2014 removing ~ 600 million barrels of liquid from global markets since Nov 2016 against ~ 157 million barrels addition from US shale.

Source: BP Statistical Review 2017

The Shale Revolution

U.S. crude oil production in AEO2018 Reference case (2000-2050)
million barrels per day

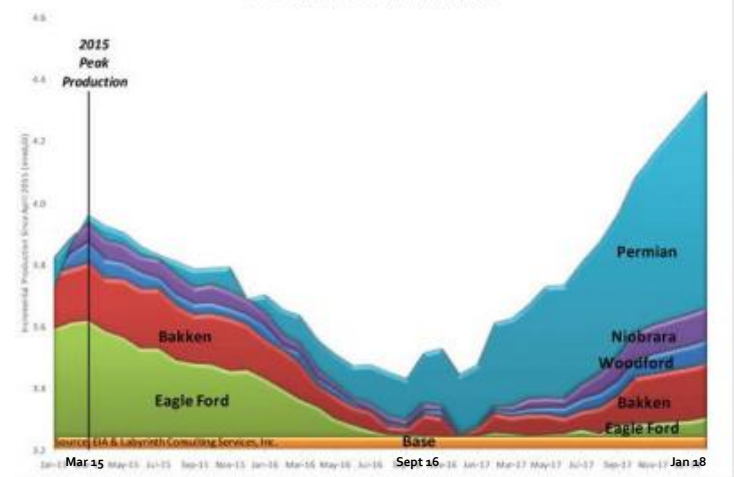


Source: U.S. Energy Information Administration, *Annual Energy Outlook 2018*

- Shale production made up 54% of USA production in 2017
- EIA forecasts suggest US 'shale' will continue to increase to 2040 when it will surpass 8.2Mb/d accounting for 70% of total US production.
- US acreage access, existing infrastructure, and a skilled workforce combined with technological innovation led the shale revolution.
- This was compounded by macro economic factors as margin investors sought lower risk investments in an uncertain world of low oil price, low interest rates and global conflicts.

Source: US Energy Information Administration & Labyrinth Consulting Services

Eagle Ford & Bakken Tight Oil Incremental Decline From Peak 2015 Levels
Is As Dramatic As Permian Increase



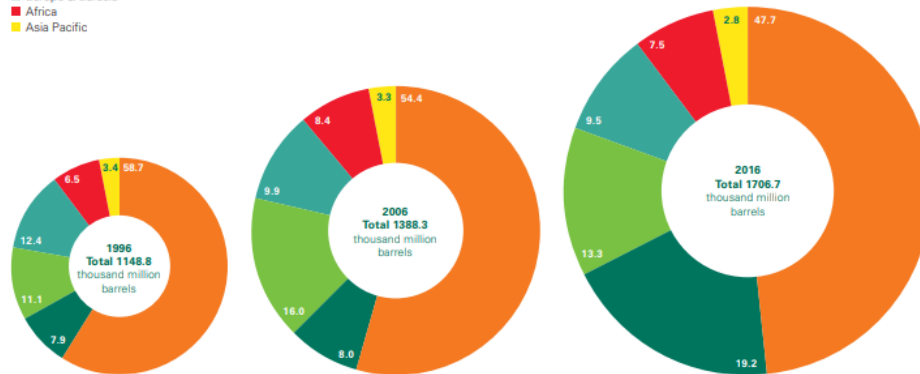
- To meet the EIA (AEO 2017 forecast) more than 1 million shale oil wells would need to be drilled between 2015 – 2020.
- It would require \$5.7 trillion of investment and require 100% of proven reserves and 60 – 73% of unproven reserves to be realised.
- This can only be met by huge technological improvements/changes.
- Challenges for US shale are geological in nature related to sweet spot maturity and water breakthrough.
- And economic – servicing the existing debt and finding new investment.

The Reserves Replacement Future

Oil

Distribution of proved reserves in 1996, 2006 and 2016
Percentage

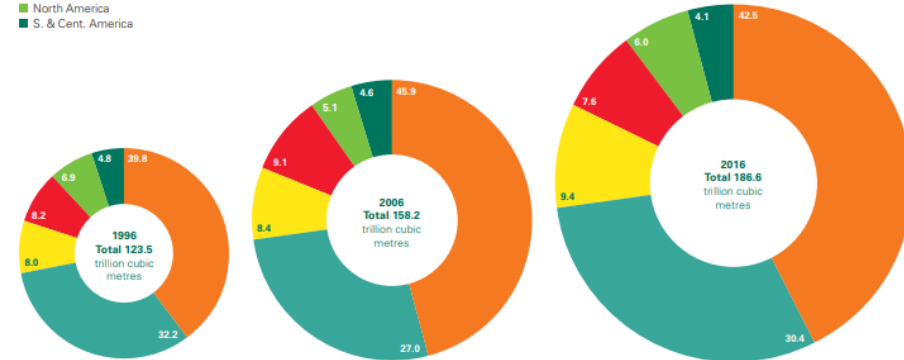
■ Middle East
■ S. & Cent. America
■ North America
■ Europe & Eurasia
■ Africa
■ Asia Pacific



Natural Gas

Distribution of proved reserves in 1996, 2006 and 2016
Percentage

■ Middle East
■ Europe & Eurasia
■ Asia Pacific
■ Africa
■ North America
■ S. & Cent. America

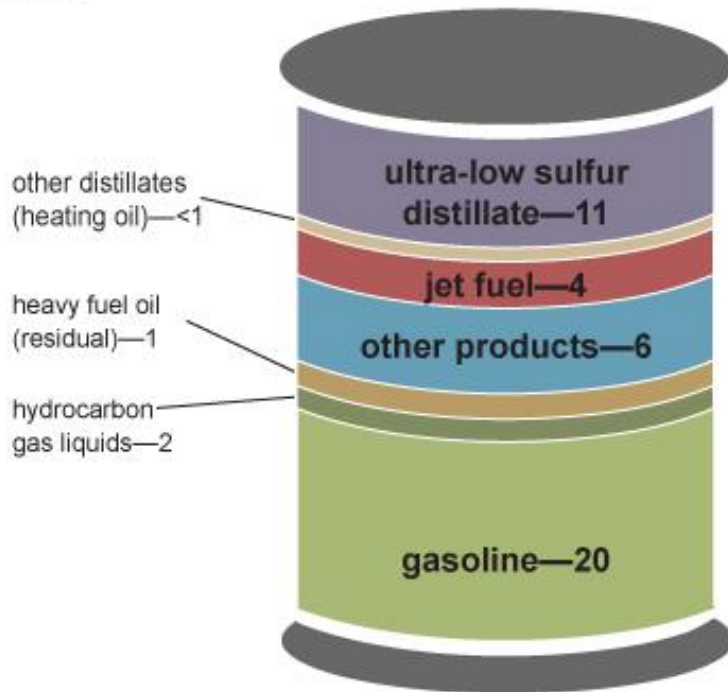


- Global proven oil reserves rose by 15 billion barrels in 2016 (0.9%).
- Total global proven oil reserves currently stands at 1707 billion barrels. Sufficient to meet 51 years of global production at current production levels.
- Roughly 50% of those reserves remain in the Middle East.

Hydrocarbon Usage (USA only)

Petroleum products made from a barrel of crude oil, 2016

volumes



Note: A 42-gallon (U.S.) barrel of crude oil yields about 45 gallons of petroleum products because of refinery processing gain. The sum of the product amounts in the image may not equal 45 because of independent rounding.

Source: U.S. Energy Information Administration, *Petroleum Supply Monthly*, February 2017, preliminary data for 2016

- ~44% Petrol (gasoline) 9.3Mb/d
- ~24% Distillate fuel oil (diesel and heating oil) 3.9 Mb/d
- ~13% Other products typically petrochemical feedstocks 2.5 Mb/d
- ~1% Jet fuel 1.6 Mb/d
- ~17% Napthas, coke, asphalt, waxes, lubricants etc. 2.3 Mb/d
- Is the hydrocarbon resource finite and is this the appropriate allocation of resource?

Renewable Energy



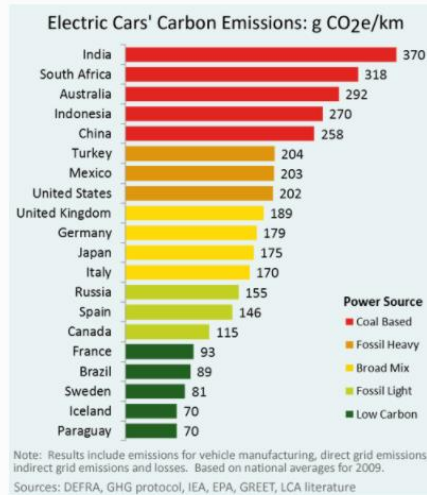
Source: BP & UK Government

- Global renewable power grew by 14.1% in 2016 with the largest incremental contribution on record 53 thousand tonnes oil equivalent.
- Wind provided more than half of renewables growth, with solar contributing a third.
- China overtook the USA as the largest single producer with Asia/Pacific passing Europe & Eurasia.
- Global nuclear power generation increased by 1.3% 9.3 thousand tonnes oil equivalent all from China.
- Hydroelectric power generation rose by 2.8% - 27.1 thousand tonnes oil equivalent.

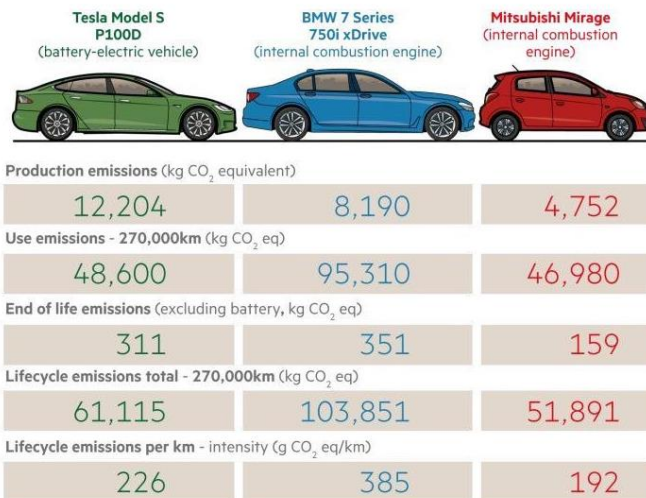
UK Alone

- 8.9% of total energy consumption in the UK came from renewable sources
- Renewable electricity represented 24.6 % of total UK generation, renewables in heat 6.2%, and renewables in transport 4.5%.

Electric Vehicles Lifecycle



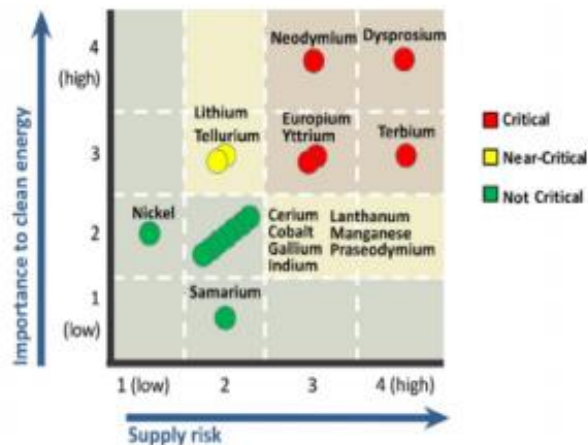
Green credentials Average lifecycle for car in US midwest



All data are based on vehicles driven in the US midwest
Source: Trancik Lab, MIT
© FT

Source: Trancik Lab MIT & US Department Environment

- 750,000 sales worldwide in 2016
- 29% Market Share
- 40% of all EV's are sold in China
- EV stock double in 1 year
- Electric cars are a green as the energy used to power them when compared on a total emissions basis with an internal combustion engine.
- EV technology is in its early stages of development and will only get better.
- Critical metal availability proposes a greater challenge to EV's and a renewable transport future than a low oil price.

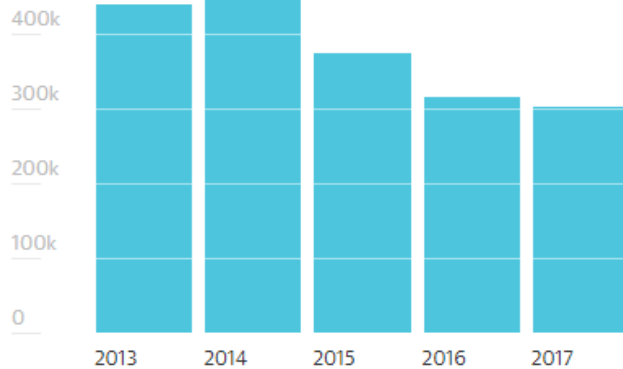


Medium term (5-15 years)
criticality matrix. US (DoE)

People

The UK oil and gas sector is still shedding jobs

Total jobs (includes indirect jobs)



Guardian graphic | Source: Oil & Gas UK

- In the UK alone 185,000 jobs have been lost between 2014 – 2016 with a further 13,000 jobs lost in 2017.
- 1900 jobs a week (the equivalent of 50 steelworks or 1 steelworks every two weeks.)
- Bi Modal age distribution both onshore and offshore 45 – 60 and 25 – 35 the second peak reflecting 2002 recruitment at the higher oil price
- Less than 3% geoscientists or less than 250 people offshore younger than 25.
- How many of the 198,000 workers lost will return to the industry in the next up cycle?

PESGB

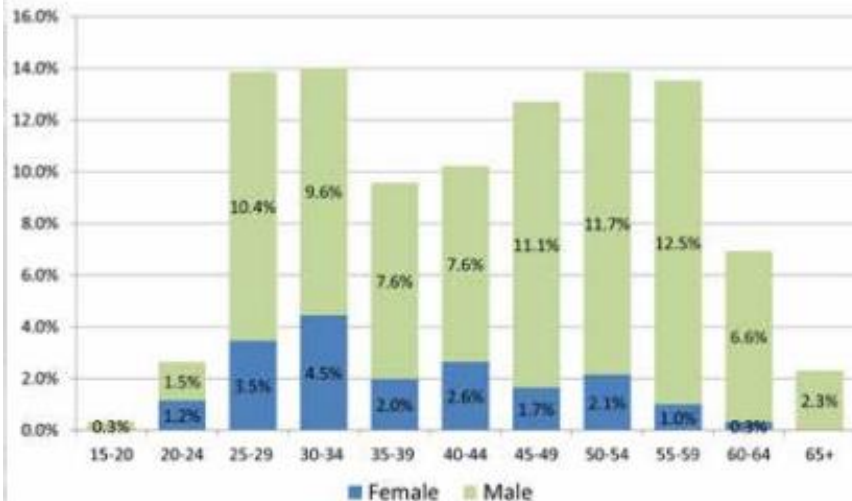
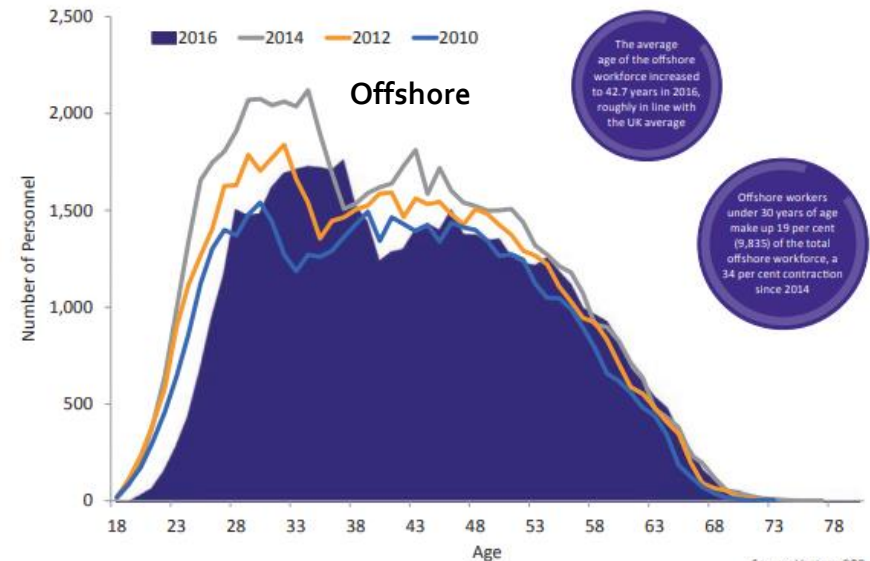


Fig. 1



Source: Vantage POB

In Summary

- The global economy is still dependent on hydrocarbons with over 50% of refined products being used in transportation of people and goods.
- Renewables account for 3% of global power generation but have the largest growth in the energy sector with wind and hydro leading the way.
- The oil industry continues to replace resource and has 51 years production of identified reserves at current production levels. Timing and delivery of these reserves will oscillate with investment .
- Whilst shale currently delivers 54% of US production this has major challenges both geological and commercial.
- Electric vehicle manufacture doubled last year and improvements in manufacturing and performance will continue to increase this. Currently they are only as green as the energy used to charge them but this will change.
- The industry is aging and we have lost a lot of experience that will not return to the industry. We run the risk of repeating old mistakes.

But What of the Future

- Growth in developing economies will continue to drive energy demand but at a slower pace with efficiencies and renewables reducing energy usage in developed countries.
- The global energy mix will be the most diverse we've ever seen as we move to 2040 with gas and renewables increasing with a reduction in oil and coal.
- Renewables are the fastest growing fuel source, a trend that is likely to continue with increased social conscience as long as there is the wealth to sustain it.
- Natural gas demand will continue to grow to overtaking coal with oil and gas remaining to account for 50% of the world's energy.
- So yes I would recommend my children getting into the 'energy industry' but it will be a different industry from the one I have grown up in.
- It has always been technologically led but digitalisation will continue to drive this and we may be exploring for rare metals as well as hydrocarbons which opens up the abyssal oceans and potentially space.

Thank You

Tim Davies

