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WHAT HAS ROBBIE BURNS BEEN BUYING IN THE SELL-OFF?

BY STEPHEN SANDERSON, EXECUTIVE CHAIRMAN, UK OIL & GAS INVESTMENTS PLC

SHALE: A NEW WORLD OIL ORDER?

When my generation of petroleum geologists began our careers in the late 1970s, it was a widely-held belief that oil reserves would be close to exhaustion by now. Prices were forecast to be hundreds of dollars per barrel by 2000; hopes were pinned on new energy technologies to keep the lights on. How things have changed! Instead, the oil and gas industry has reinvented itself and we witness the possibility of a new era in the global economics of oil.

In 2016 the world has so much oil that it's predicted that we'll never exhaust oil reserves. That's quite a sea change in 30-odd years. Global proven reserves (i.e. oil the world has genuine access to) now stand at 2.4 trillion barrels. If we include oil yet to be found by exploration in known oil provinces (oil that has less certain access) the total exceeds a whopping 7 trillion barrels.

Essentially, in the last 35 years, for every barrel of oil we've used, another two have been added to the stockpile. In spite of increased energy efficiencies and new renewable technologies, the world's oil demand still continues to rise in overall terms. Global oil consumption to 2050 is now forecast to be 2.1 trillion barrels. This still leaves plenty in the global oil tank for later generations if they need it.

These new oil reserves come from areas barely on the radar screen 20 years ago. New technologies and efficiencies have been invented to make them work. As a consequence, the extraction costs from areas such as ultra-deepwater South Atlantic, Gulf of Mexico, onshore Arctic, and US shale oil are amongst the highest on the planet. They require high oil prices to justify investment and the inherent risks.

With the exception of Saudi Arabia, Kuwait and the other core Persian Gulf OPEC producers, the majority of

current global oil reserves need prices well above $30-40 per barrel to simply balance day to day operational extraction costs, let alone pay back finance and make money.

Over the past ten years, excepting the 2008-09 slump, oil prices have been over $60 a barrel – a historical high. Prices exceeded $100 in 2008 and from 2011 to late 2014. Resultant extraction has reached record levels. A free market has been operating since 2009, with little or no significant OPEC intervention increasing global oversupply.

Current oversupply is now almost 1.8 to 2 million barrels per day (bopd), which is more than the UK's total consumption of 1.4 million bopd. Roughly just under half of all oversupply comes from OPEC, with the remainder from increased North American tight oil (shale) production. Tanks, pipelines and oil bunkers are full. This oversupply, exacerbated by slightly lower than predicted global demand growth, particularly in Asia and China, has led to yet another spectacular oil price crash, the fourth I've witnessed in my career.

For 30 years until November 2014, the 13 members of OPEC acted as a shock absorber to such oil price fluctuations, levelling off a rocky terrain to help smooth the market's ride.

Indeed, one of the key assumptions in the historic model for the economics of oil, as eloquently described by BP's chief economist Spencer Dale, has been that OPEC is the global swing producer. The model also relies heavily on the assumption that oil is derived from conventional fields that require huge up-front investment and which take years to ramp up or lower production. Shale oil with a fundamentally shorter cycle time than conventional oil likely renders the old model obsolete.

"ESSENTIALLY, IN THE LAST 35 YEARS, FOR EVERY BARREL OF OIL WE'VE USED, ANOTHER TWO HAVE BEEN ADDED TO THE STOCKPILE."

Since about 2011 OPEC have consciously not intervened to cut global supply. As a consequence, oil prices are at a 13-year low hovering at $30. Brent crude has lost three-quarters of its value since mid-2014. Just as in the middle of the 2008-09 recession, when oil prices fell off a proverbial cliff from $145 to $35 a barrel, the collapse, yet again, appears to have taken forecasters somewhat by surprise.

At $30 all oil producers lose. Even Saudi Arabia, reliant on deriving 90% of its budget-funding from its 10 million barrels per day, struggles. It is calculated that to pay off the Saudi 2015 budget requires an oil price of $106.

OPEC members such as Algeria, Angola, Libya, Nigeria, Qatar and Venezuela make precious little money at $30, as only 1% to 10% of their reserves are economically viable. For non-OPEC producers, particularly high cost areas, such as the North Sea and deep water Brazil and West Africa, $30 is an unmitigated disaster. Russia struggles, as does the US and its shale oil.

OPEC's failure to cut production is cited as an effort to crush US shale oil and to restore market share. Failure to intervene also raises questions as to whether the old economic model of oil is broken and needs updating. People point to shale, or tight oil, in the US as the prime reason behind the non-intervention citing economic warfare or simply a failure by OPEC to adapt to the impact and reality of shale.

From a near standing start in 2008, US shale oil production has increased to around 4.5 million bopd in 2015 – almost twice the expansion in global oil demand. Peak US production in June 2015 of 9.6 million bopd was briefly on a par with Saudi output. Even though US shale accounts for only 5% of global supply, this is clearly worrying for OPEC and in particular Saudi Arabia. But what is shale?

As a rock, shale is like a softer version of slates on the roof. It is made of mud and clay particles that settled out, in seasonal layers, over millions of years at the bottom of the sea or, in some cases, large lakes. Certain shales have the remains of gazillions of plankton, bacteria, algae and other microscopic flora and fauna that settled and accumulated along with the mud.

What's exciting for geologists is that when the mix of mud, clay and organic matter is buried and heated in the earth's crust, it generates hydrocarbons. Oil first, then with increasing heat and pressure, natural gas. This is where all the oil and most of the natural gas on the planet originates. Geologists call these shales source rocks.

Conventional oil fields result from a fraction of the generated oil escaping from the source rock, migrating upwards to shallower levels (oil is less dense than water) and then being trapped in a porous permeable rock (a reservoir – typically sandstones and limestones). We suck out the oil from the reservoir using the well as a straw.

The best home-grown example of a shale source rock can be seen along the UK's Dorset heritage coastline around Kimmeridge Bay. This is the Kimmeridge clay. Pick up a fresh piece and it smells of oil; put a flame to it and it burns. Oil seeps can be seen a few metres offshore. It looks a bit like the rock equivalent of brown-coloured chocolate mille-feuille.

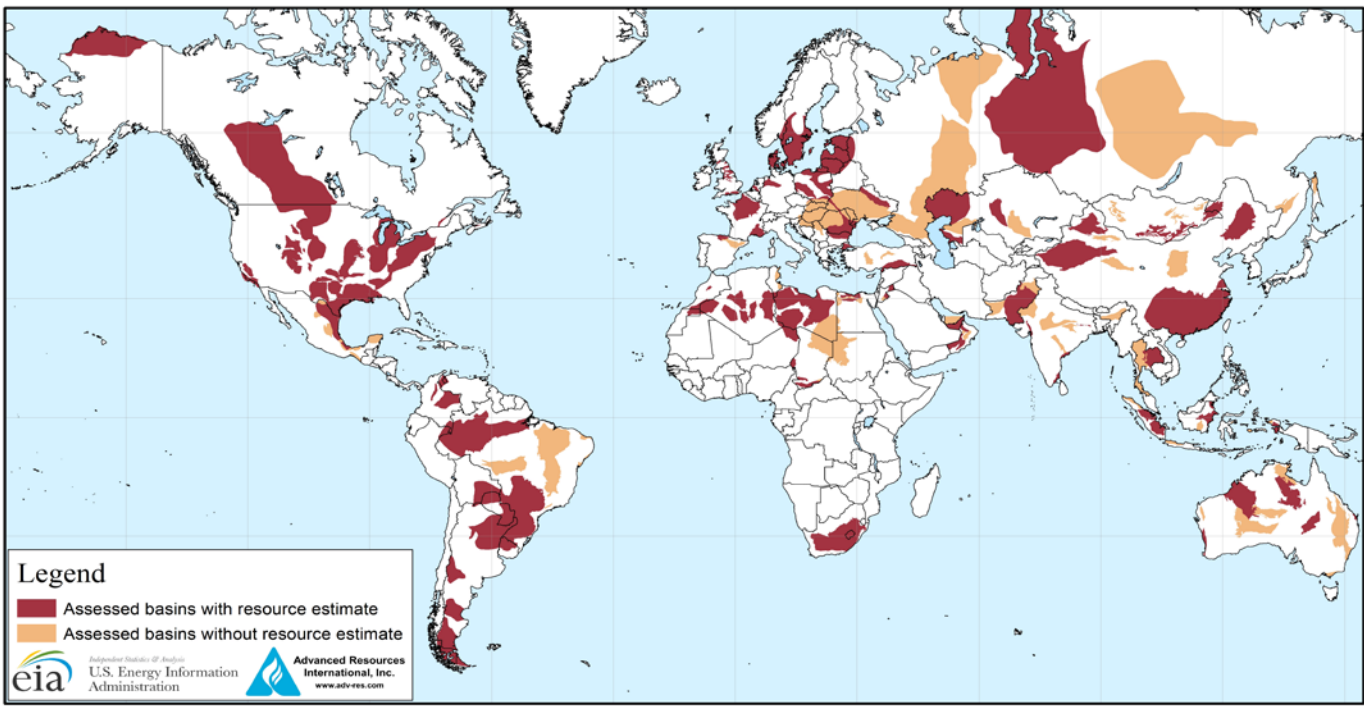
"FROM A NEAR STANDING START IN 2008, US SHALE OIL PRODUCTION HAS INCREASED TO AROUND 4.5 MILLION BOPD IN 2015 – ALMOST TWICE THE EXPANSION IN GLOBAL OIL DEMAND."

The Kimmeridge clay is also found under the North Sea and is the source of the 42 billion barrels of oil produced from its conventional fields. This figure represents only a fraction of oil that migrated from the source rock to be trapped in oil fields. Some 500 billion barrels is estimated to remain in the source rock itself. The same Kimmeridge source rock also underlies the Weald of south east England, but more on this later.

Until 15 years ago geological wisdom decreed that commercial extraction of oil from shale was impossible and uneconomic, since, like their more well-cooked cousins, slates, shales are impermeable. In their natural state oil and gas does not flow readily out of shales.

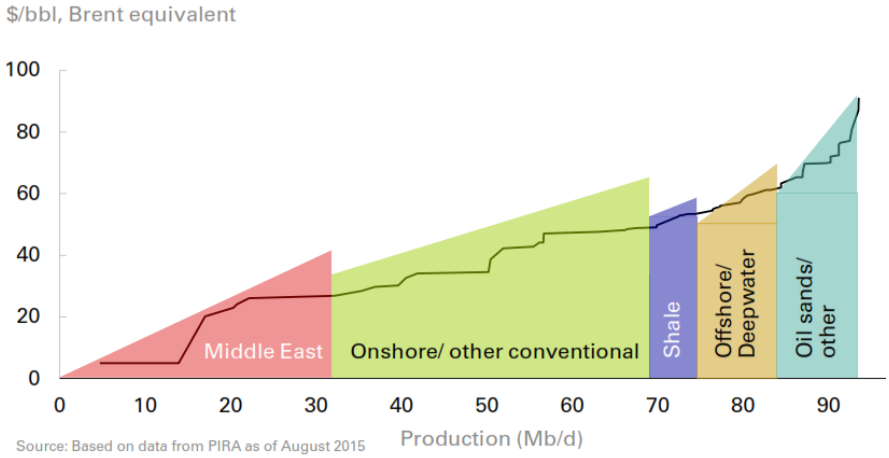
Thirteen or so years ago, smart folks in the United States adapted hydraulic fracturing (fracking) – something that's been around since the 1940s – to solve the problem. This involves injecting high pressure water into shales from horizontal wells to create a new 'man-made' rock fabric that joined up the shale's oil and gas-filled microscopic pore spaces. The oil could then flow into the well bore and to surface. Whilst a very high cost process at first, the costs of the fracking technique, in conjunction with long horizontal wells, has seen major cost reductions and efficiency improvements.

Estimates of oil contained in source rocks are staggering at almost 7 trillion barrels in the ground. The Bashenov shale in western Siberia, the world's largest, is estimated to contain over 1.2 trillion barrels, while the Bakken, one of the two largest shale producers in the US, is about a third of the size at 413 billion barrels. Even with estimated recoveries of about 5% of oil in the ground, the prize is large.



"LIKE MANY INDUSTRIAL PROCESSES, FRACKING HAS GENERATED INCREDIBLE PRODUCTIVITY GAINS."

Stylised oil production cost curve



Source: Based on data from PIRA as of August 2015

Potentially recoverable shale oil resources have been identified in 41 countries, mostly onshore and at shallow to modest depths. Attributed reserves, as of 2013, show that shale accounts for 10% of global oil reserves and over 30% of gas reserves. This is a conservative estimate. According to the US Energy Information Administration, over 50% of oil shale resources lie in Russia, the US, China and Argentina. Libya is the only OPEC member to fall in the global top 10. This is a potentially significant swing in the future balance of oil-supply power.

Shale source rocks are regionally extensive and relatively homogenous geological units. They have far less geological uncertainty than conventional reservoirs. As a consequence, shale can readily support the almost standardised, repeated, manufacturing-like drilling and fracking production process required to reduce costs and grow production. Continual drilling of back-to-back wells is necessary to combat the very steep 60-75% production decline of shale wells in their early lives.

Like many industrial processes, fracking has generated incredible productivity gains. Productivity growth, as measured by initial oil and gas production per rig, averaged over 30% per year between 2007 and 2014. This has clearly helped the economics of shale and made it more robust than expected in the face of a falling oil price.

One of the key points about the meteoric rise of US shale oil is the rapidity from investment decision to production. This has been facilitated by short well-permitting times (less than a month in Texas) and the increasing efficiency of the industrial drilling and fracking process, resulting in drilling to completion times typically of 15 to 30 days.

The short production lags and high decline rates of shale wells also mean there is a far closer correlation between investment and oil production. Investment decisions impact production far more quickly, while production levels fall off equally quickly unless investment is maintained. Shale is also more dependent on the banking and financial system to provide the capital for the small and medium-size companies involved, thereby increasing the exposure of the oil market to financial shocks.

The greater potential responsiveness of US shale to prices means that cyclical movements in shale production could also eventually help to stabilise the market. Shale oil thus has the potential to be an additional short-term shock absorber for the global oil market to help stabilise price volatility. OPEC's ability to stabilise the market in response to short-lived, temporary shocks still remains largely unaffected. But OPEC's role, and particularly Saudi Arabia's, remains dominant. The Saudis are still the only ones with any margin of spare capacity.

US shale oil has been far more resilient to the price drop than OPEC or anyone expected. This has been helped by production efficiencies and also by significant hedging and re-financing. The Russians claim this was worth $150 million a day, which is effectively a subsidy for shale oil preventing a more rapid decline and exacerbating the oil price slump.

The writing is finally on the wall that shale oil production will drop. The number of wells permitted for shale drilling in 2015 in Texas alone dropped from its peak of 5,600 in 2014 to 2,400, a level lower than 2011. Rig counts have also dropped markedly. North Dakota had only 49 active rigs, the lowest since 2009 and well below the peak of 219 in 2012. Analysts now expect US shale production to drop by almost 1 million bopd in the next 12 to 18 months.

Therefore, we are about to see the market corrected by a combination of

the removal of supply by a significant drop in US shale production combined with the possibility of a 5% production cut by OPEC, perhaps even in conjunction with Russia. The future is still uncertain, but undoubtedly there is a glimmer of sunshine.

Meanwhile, the potential impact of low prices and shale on the UK is profound. Simply put, the vast majority of the North Sea's current 800,000 bopd makes zero or little return at $30 oil. A breakeven of $50 per barrel is cited by many analysts. So, there is a real prospect that the 375,000 jobs which are directly or indirectly associated are still at risk if prices only recover to $50-60.

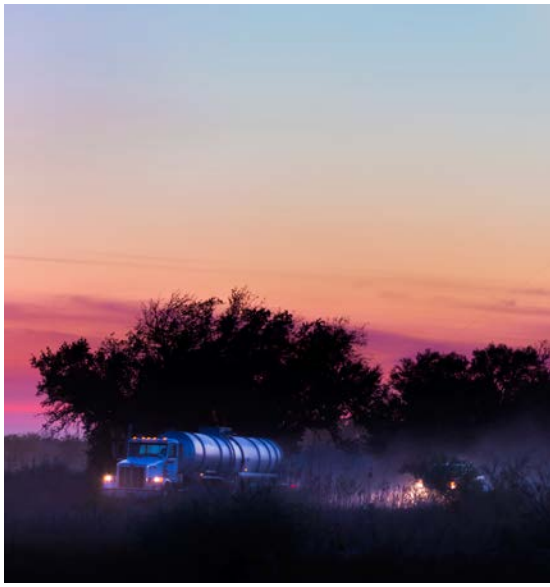
We have seen the usual round of knee-jerk job cuts by the majors. This happens during all price downturns. It's very short sighted. Fortunately, for me, the UK onshore sector is far more robust to prices, as its older fields break-even at around $18 to $25. However, oil production is small at only 20,000 bopd. New onshore production is looking far more challenged than in 2014.

"THE US SHALE REVOLUTION OFFERS A RAY OF HOPE FOR THE UK."

Tax revenues from North Sea production were significant until the price drop. In 2010 they amounted to £11bn, which fell to £2.2bn in 2014-15, and is now projected to be just £130m in 2015-16. Indirect taxes and revenues were also highly significant. Taxes on the oil industry are high compared to those on other UK industry. The oil industry pays a 30% rate of Corporation Tax, versus the standard 20%, plus a further 20% supplemental tax on oil revenues. Additional levies can take this up to an overall take of 67.5% of profits.

If the government is serious about the economic value of the offshore oil industry and energy security, it should fundamentally re-think the tax structure for oil (and gas) in the UK to help sustain production, jobs and the fantastic oil expertise and knowledge base that the UK industry possesses.

Tax cuts would also serve as a stimulus to new onshore oil and gas activities capable of significantly adding to UK energy security, taxes, jobs and economic growth, such as shale. Interestingly, Mr Putin, not considered one of the world's most enlightened



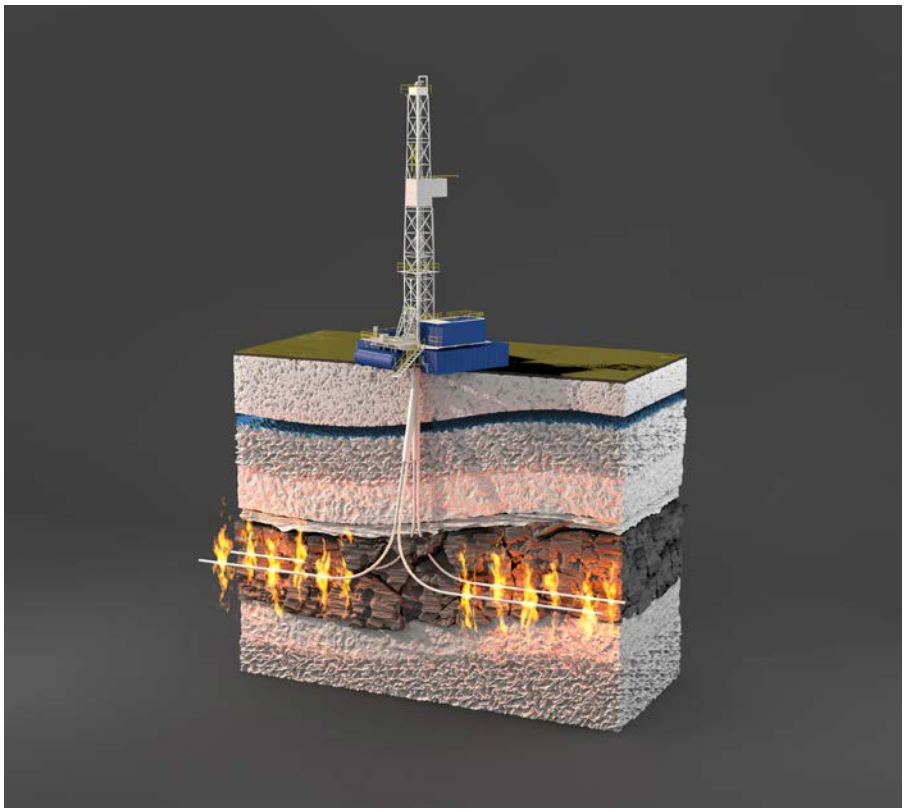
capitalists, has introduced 'tight oil' tax relief which would grant a discount of 50-100% on mineral extraction tax. Should we buy Russian tight oil when we have the potential of our own UK tight oil?

Tax cuts will still not alter the fact that UK offshore oil (and gas) has a very high cost structure. Innovation is needed to reduce costs and perhaps implement some of the industrial process methodologies used so successfully by US shale.

Stepping back, it's clear that the whole oil price collapse involving the issues with OPEC versus the US, and of Russia as potentially the world's largest producer of shale oil, should ring warning bells in 10 Downing Street. Energy security is more critical than ever. The UK produces about 60% of its daily oil consumption and this is declining rapidly. This means that the UK's energy security is under increased threat.

Obviously the best form of energy security is indigenous production and the tax, jobs, revenue and expertise that arises. The US shale revolution offers a ray of hope for the UK. We have plenty of world class shale here in the UK onshore.

The focus has been initially on gas from the Bowland Shale and others in the north of England. If proven to be technically and commercially feasible, the high activity shale gas scenario could generate 4 to 9 trillion cubic feet of gas – more than six times the gas produced in the UK in 2012, or more than twice the gas consumed in the UK



"WHILST THE POTENTIAL EXISTS IN THE UK FOR SHALE, THERE ARE STILL SIGNIFICANT BARRIERS TO PROVING THAT IT WORKS IN THE UK, WHICH ONLY GOVERNMENT CAN RESOLVE."

per annum. This could create 16,000 to 32,000 direct, indirect and induced jobs: a very significant prize for the UK.

Until very recently, tight oil and oil shale was not even on the UK radar screen. Hopefully **UK Oil & Gas Investments PLC's (UKOG)** activities in the Weald basin of south-east England have raised awareness of the potential for significant tight oil production to help assist UK energy security. If successful, the impact could be similar to that of shale gas.

Following the drilling of UKOG's Horse Hill well in 2014, world renowned analysts Nutech estimated, in October last year, that there are 124 billion barrels of tight oil in the ground in a 1,261 sq mile area of the Weald. Approximately 80 billion barrels are in Kimmeridge clay. The first extraction target lies within two limestones in the Kimmeridge, which Nutech calculate to contain 19.5 billion barrels of oil in the ground. These are serious numbers from a serious business.

Ernst & Young (EY) will soon publish a study which assesses the potential economic impact and benefits of tight oil extraction from these Kimmeridge limestones. EY show that production could contribute between 4% and 27% of the UK's current oil consumption with an associated total value contribution to the economy of £7 to £53 billion over the life of the project.

The Chancellor will be particularly interested to read that tax contributions could be anything from £2-18 billion. Remember that these figures only represent extraction from 19.5 billion barrels in the ground; there is a further 100 billion still in the UK oil tank for later. But let's not get too carried away. UKOG have to test and drill a lot more wells, but the potential is there.

Whilst the potential exists in the UK for shale, there are still significant barriers to proving that it works in the UK, which only government can resolve. One of the key attributes of US shale success is the short cycle time. Investment to production decision is in weeks to months.

Currently we have a major stumbling block here in that it takes up to two years to get a permit to drill. This is a stark contrast to the US. The Government has stepped in with planning consents which theoretically reduce approval times to 16 weeks; however, there are a total of four agencies that are required to grant approval, each with their own bureaucracy and agenda. A single UK-wide authority with the technical knowledge to approve drilling is needed to make shale happen here.

It is the failure of the well permitting system in the UK that has stopped the industry from moving forwards. As a result, to date, due to planning and permit delays, there is not one single well in the UK that demonstrates that shale gas or tight oil is fully technically feasible. This is a ridiculous state of affairs for a government committed to shale.

Another driver for the US boom is the fact that shale landowners are rewarded with a chunk of the royalties, making them fully aligned and incentivised; whereas in this country, and indeed most of the world, oil and gas rights are the property of the state. The industry recognises that local communities surrounding any developments should be similarly rewarded to the US, as should local councils via business rate taxes. Shale gas has openly committed to cash payments and a 1% royalty; but this scheme should be extended to all new onshore oil and gas. Buy in and a share of the reward is absolutely essential to make shale work.

There are also a number of issues relating to depth ceilings of massive hydraulic fracturing. Currently fracking is not permitted above 1,000m, despite there being no evidence to support this ceiling. To the contrary there are approximately 64,000 wells in the US above this celling that have been massively fracked and produce hydrocarbons with no reported adverse effect on the environment.

This depth ceiling may not impact shale gas as that is located mostly below 1,000m. Tight oil and shale oil are by definition situated at shallower depths and they also do not have the issues of gas seepage and fugitive gas emissions. Some clearer scientific thinking is needed by government in order for significant chunks of oil potential not to be removed by arbitrary regulations.

Finally, while the overall low oil prices are worrying in the short term, this is the perfect time for sound companies with good management, good underpinning assets and cash to enlarge their businesses and emerge stronger when prices rise. Rockefeller's maxim of "buy when the blood is running" still rings true.