Resources and Energy

Things that may interest you

- "The stone age came to an end, not for lack of stones, and the oil age will end, but not for lack of oil" – Sheikh Yamani, former Saudi oil minister and a founder of OPEC.
- The chief causes of minerals scarcity are growing demand (65%), geopolitics (54%), exhaustion of reserves (30%) and lack of substitutes – the latter mainly in high tech and chemicals.
- On average everyone on Earth uses 16kg of resources dug out of the earth *every day* - metals, minerals and fossil energy. In the developed world it is 57kg per person.
- Mobile phones are made from as many as 42 different minerals, including aluminium, copper, beryllium, coal, gold, iron, limestone, silica, silver, talc and wollastonite. A television uses 35 different minerals and a computer more than 30.

The problem here is not resources running out. The problem is that the cost of extracting resources is rising – the financial, environmental, political and human costs. When inputs equal or exceed payoffs, the resource 'runs out' – it is not viable. It isn't gone – it's just uneconomic to extract.

This concerns EROEI – energy returned on energy invested. Getting more energy out than you put in creates economic growth, and putting in more energy than you get out leads to economic contraction. The world has profited greatly from cheap energy derived from coal and oil and from easy access to other resources, generating tremendous economic growth in the last century or two.

But these times are drawing to a close. We are at *peak resources* and we have a problem.

The resources we need most to worry about are: 1. drinkable water; 2. fertile soil; 3. phosphorus (for chemical fertilisers); 4. forest; 5. accessible oil; 6. certain minerals (such as gypsum, bauxite, titanium, mica and rare earths); 7. iron; 8. natural gas; 9. helium, and 10. coal.

When a resource is exploited, the easiest deposits and means of extracting it are used first. Today exploitation requires more effort, expense, technology and environmental damage – examples being deep-sea oil drilling and fracking, which currently are only just viable. Using new technologies that allow extraction of previously inaccessible oil and gas, they are costly, sophisticated and risky. Safety, environmental and other legislation, together with risk liabilities, fines, expense and, in places, population density, make extraction operations more difficult than before.

New technologies make a big difference. New extraction and processing technologies make production cheaper or cleaner or they open up new sources. Also, new technologies replace old ones – recent advances in solar and wind power mean that they underprice oil and nuclear power, making change to renewables not only more viable but also inevitable. But even solar and wind require special metals, land-use and processes that have limits, costs and harms. Everything charges its price, but some things are better than others.

Use of limited-supply metals can to an extent be replaced by new materials such as carbon-fibre and nano-materials, but these too charge an environmental cost in manufacture and disposal. Carbon fibre comes from oil, it cannot be recycled and it doesn't rot or rust away. Metal recycling is increasingly used but, except with lead, metals deteriorate in quality when recycled, which matters a lot in some applications, so recyclability is not perpetual. Minerals such as rare earths, used in high-tech and low-carbon applications, are particularly at risk of running out.

Prices rise in response either to falling supply or to rising demand, making exploitation more profitable and thus contributing further to resource exhaustion – this destructive quirk in capitalism makes us eat up resources until they are gone. Overconsumption strips assets from the future. Two key factors affecting resource availability are wars (such as the many oil-related wars in the Middle East) and geostrategic risks (such as closure of the Persian Gulf, Malacca Straits or Suez Canal). China has 70% of known rare earths, and other rare elements come from Argentina, Chile, Bolivia, Congo and Afghanistan – not the most stable of countries. Nations' export controls, and also geopolitical measures such as sanctions constitute another problem affecting supplies.

There is a difference between *deposits* and *reserves*. Reserves are explored, assessed and known deposits that can be exploited. Only 10% of exploration efforts lead to viable reserves. Owing to the high cost of exploration, plenty of deposits have not yet been explored or discovered. Many deposits are deep, difficult to access, poor in yield or environmentally damaging to extract. Unexploited wilderness space is itself becoming a rare resource.

Some minerals such as arsenic, selenium and lithium can be accessed only as a by-product of extracting other minerals, so their availability depends on the extraction economics of those minerals. Of concern are rare minerals such as indium (for LEDs, LCDs, computers and phones), ruthenium (photovoltaics), gallium (semiconductors, lasers and LEDs), neodymium (hybrid and jet engines), europium and yttrium (fibre optics and lighting) and rhenium (jet engines) – all important for high-tech applications. Since these metals are used in microscopic quantities they are difficult to recycle. Other minerals on the critical list are beryllium (aerospace), cobalt (jet engines and batteries), tantalum (phones, computers and car electronics), fluorspar (construction, cement, glass) and lithium (batteries and wind turbines).

Countries with the highest mineral depletion are Australia, Brazil, Chile, China and South Africa. Australia is the largest producer of bauxite, Brazil of industrial diamonds, China of tungsten, and South Africa of platinum and gold. The last major deposit of copper, vital in electronics, was discovered in Mongolia back in 2002 – copper is at risk too, and we have only 40-60 years of known reserves left. Copper is vital in electronics.

One big answer is consumption reduction – for example, redesigning phones to last 20 or more years, with repairable and upgradeable critical parts, or making better use of limited materials and allowing more efficient recycling. Items can be better made, and planned obsolescence, short-lived consumer fashions and disposable gizmos must go – longterm survival is, in the end, more important than short-term corporate profit margins. Business does not agree – reuse, repair and recycling are not good for businesses' balance sheets but they're coming anyway.

What's this about peak oil and peak anything? A peak concerns the maximum output of a resource – it plateaus before gradually sinking. It does not run out, but it becomes more expensive if demand rises – and, in general, demand rises because global population, GDP and consumption are rising. Fracking and deep-sea drilling have extended oil's peak of production – it is environmental, not supply concerns, that will cause oil's decline. So 'peak milk' can mean that production output remains the same but demand rises. Demand for a resource can decline when a new technology arrives to replace it – as with fossil fuels in coming decades, being replaced with renewables. Most foods and many other resources peaked around 1990-2010. From now on, unless demand falls, their cost will rise, because their production output is in most cases not significantly increasing.

Then we come to fossil fuels. Coal is plenteous (with 188 years of reserves at current consumption rates), and oil (45 years) and gas (55 years) are sufficient but they will become uneconomic in due course. Demand for fossil fuels will sink as time goes on – this depends on policy decisions, tech developments, alternative energy sources and energy consumption rates. The world has used only about 5% of technically recoverable oil, but the price of extracting it will rise, eventually becoming unviable. Even if we stop using oil for energy, it will still be useful longterm for other applications such as plastics. While plastics bring enormous environmental problems, demand and disposal problems can be significantly reduced, though plastics are unlikely to be completely replaced.

Demand for oil will continue because replacement technologies take time to develop. Demand growth is slowing as a result of fuel efficiency, internet use (meaning less travel), slowing population and economic growth and an overall increase in service industries (using less energy). Policy decisions and ever cheaper renewable technologies will cut demand further. By 2050, energy intensity – the amount of energy used to produce a unit rise in GDP – will be half what it was in 2013. In the energy sector, 77% of demand growth is projected to be fulfilled by renewables by 2050 but, unless there are bold policy decisions or technological breakthroughs, non-hydro renewables will still likely provide only 35% of all energy consumed globally. In 2014 it was 6%.

Global demand for coal is expected to peak around 2025 and oil around 2030. At current rates, greenhouse gas emissions will flatten and fall around 2035, leading us to an expected 3°C average temperature rise by late century, if global warming forecasts are correct. If people want better than this, they will have to pay for it in higher energy prices and by sharply reducing demand. Even if further discoveries are made in renewable energy generation and transport, the investment involved in transition is staggering, so transition is not an overnight, easy phenomenon. It is costly.

Summing up, some specific resources (such as rare earths and copper) are in short supply and they are likely to create a problem. Other resources such as clean water and viable land are a cause for great concern. Further resources will become unviable later this century. It all hangs around cutting demand, good policy decisions, technological substitutes, geopolitical solutions and new discoveries of reserves. Geopolitical issues are critical inasmuch as a political crisis or war can cause spikes in supply and prices, at times creating great difficulties. Withholding resources or flooding the market can also be used as a means of economic war.

However, this is all rather dry and theoretical. The Kogi people of northern Colombia see things differently. In their declaration to the world made around 1990, they said this. "*We are the Elder Brothers. We have not forgotten the old ways… We know how to call the rain. If it rains too hard we know how to stop it. We call the summer. We know how to bless the world and make it flourish. But now they are killing the Mother. The Younger Brother, all he thinks about is plunder. The Mother looks after him but he does not think. He is cutting into her flesh. He is cutting into her arms. He is cutting off her breasts. He takes out her heart. He is killing the heart of the world.*" And perhaps they were addressing us not from the past but from the future.

Useful links

World Resources Institute (*website*). http://www.wri.org

Resilient People, Resilient Planet, UN report on global sustainability, 2012. https://en.unesco.org/un-sab/files/resilient-people-resilient-planet-report-un-global-sustainability-panel-gsp-2012pdf

The Nine Planetary Boundaries, Stockholm Resilience Centre, 2015. http://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html

What will be left of Earth's non-renewable resources? NCSU, 2011. http://www4.ncsu.edu/~kpadia/CS895/HW5/

Peak Planet: are we starting to consume less? New Scientist, 2012. https://www.newscientist.com/article/dn21886-peak-planet-are-we-starting-to-consume-less/

Mining and Metals in a Sustainable World, WEF, 2014. http://www3.weforum.org/docs/WEF_MM_MiningMetalSustainableWorld_ScopingPaper_2014.pdf

Minerals and Metals Scarcity in Manufacturing, PWC, 2010. https://www.pwc.com/ua/en/industry/metal_mining/assets/impact_of_minerals_metals_scarcity_on_business.pdf

World Energy 2016-2050, Peak Oil Barrel, 2016. http://peakoilbarrel.com/world-energy-2016-2050-annual-report/