OPENING PANDORA'S BOX:

The New Wave of Land Grabbing by the Extractive Industries

and

the Devastating Impact on Earth

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Front Cover
Treasure chest (cc) John Cooke, Hands - (cc) Tomas Sobek
(Images left to right) Oil soaked Pelicans from the Deepwater Horizon oil spill (cc) IBRRC, Zinc-lead-silver mine in Cerro de Pasco, Peru (cc) SkyTruth Nuclear Power Plant, Lightening (over Denver) (cc) Ramesh Iyanswamy, Leviathan Mine - (cc) Patrick Huber, Earthmover - (cc) Minnesota National Guard Lake Kemp in Texas - (cc) Patrick Huber, Child miners in the Congo - (cc) Sasha Lezhnev / Enough Project

OPENING PANDORA'S BOX

The New Wave of Land Grabbing by the Extractive Industries and the Devastating Impact on Earth

'Opening Pandora's Box' is a metaphor for our time. It is a story about how one of two brothers, *Epimetheus*, is seduced by appearances and his own desires. He did not have the forethought to look into the true nature of what he saw, or to understand the implications of his actions beyond himself. The moral of the story is that once the Earth is opened, she cannot be closed, and what we spoil we spoil forever. Mining the last remaining wildernesses and the critical ecosystems of our Earth is irreversible. The other brother, in the story, *Prometheus*, warns us that hindsight is too late and hoping for the best is ignorant and impotent. What the story recommends is foresight: from this come the gifts of a true civilisation and right relation towards the Earth, our source of life.

Dedication

We dedicate this Report to the Earth and all her children - with gratitude for her magnificent diversity of forms and expressions of Life.

We resolve to stop the destruction of your ecosystems and communities and entrust a healthy and resilient Earth Community to future generations of all species.

To the children, to all the children,
to the children who swim beneath the waves of the sea,
to those who live in the soils of the Earth,
to the children of the flowers in the meadows
and the trees in the forest, to all those children
who roam over the land
and the winged ones who fly with the winds,
to the human children too,
that all the children may go together into the future in the full
diversity of their regional communities.

Thomas Berry, 1914-2009

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Tailings pond in rural Utah/ Ron Chapple Studios/ Thinkstock

The abstract beauty of toxic tailings ponds belies the reality of the devastating impact on the surrounding environment: contamination of harmful pollutants in the wastewater can seep into groundwater or contaminate rivers, with fatal implications for human settlements and wildlife. Wild birds and large mammals are drawn to the ponds as natural pools, oblivious to the fact that they contain poisonous minerals such as arsenic, mercury or cyanide. Fish in the adjacent rivers are also often poisoned by the deadly effects of the ammonia pollutants that leach into the waterways.

ACKNOWLEDGEMENTS

We are especially grateful to Philippe Sibaud who authored this report. He spent over a year unearthing the information and painstakingly analysing and reflecting on its implications, to build the foundations of this report. Philippe has been involved in the oil industry for 18 years, first as an operator and then as a trader of crude oil on the international markets. He left the industry in 2007 to concentrate on environmental and social projects. We very much appreciate your perseverance and generosity, Philippe, and so do our partners and allies.

Thanks to our Associates and Partners who alerted us to the urgent need to analyse the global trends in the extractive industry, to get an overall perspective of what is going on. After 25 years of working with partners across the world, suddenly things changed. Since 2008, one territory after another was confronted by land grabbing for extraction - the Colombian Amazon for gold; India's tribal forest lands for bauxite; Venda, South Africa for coal; Ghana for gold - the list continues apace.

We thank the communities at the frontline of this intensifying wave for sharing your stories of courage and tragedy in the battle for sanity.

We are indebted to generous advisers who have been engaged in the extractive world for many years - some from within the industry and others working with communities, monitoring and challenging injustices, especially Richard Solly (London Mining Network), Andrew Whitmore (Mines and Communities), Roger Moody (Nostromo Research), Geoff Nettleton (PIPLinks), Andrew Hickman (Down to Earth), Nnimmo Bassey (Environmental Rights Action and Friends of the Earth International), Abdulai Darimani (Third World Network-Africa), Vandana Shiva (Navdanya), Martin Stanley (Holly Hill Trust), Martin Blake (GreenAsia Group), Paul Dickinson (Adviser), Ian Laming (Adviser), Gilbert Makore (Zimbabwe Environmental Law Association), David Fig (University of Cape Town), Andrew Muir (Wilderness Foundation), Suzanne Dhaliwal (UK Tar Sands Network) and Susan Smitten (Respecting Aboriginal Values and Environmental Needs).

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ABBREVIATIONS AND ACRONYMS

BASF Baden Aniline and Soda Factory
BP British Petroleum
BRIC Brazil, Russia, India, China
CCS Carbon Capture and Storage
CCW Coal Combustion Waste
GHG Greenhouse Gas
EEA European Environment Agency
EIA Energy Information Administration
IEA International Energy Agency
IAEA International Atomic Energy Agency
IHS CERA Information Handling Services: Cambridge Energy Research Associates
IMF International Monetary Fund
IPCC Intergovernmental Panel on Climate Change
IUCN International Union for Conservation of Nature
ITPOES Industry Taskforce on Peak Oil and Energy Security
MEP Member of the European Parliament
MTR Mountain Top Removal
MII Mineral Information Institute
OECD Organisation for Economic Cooperation and Development
ONS Office for National Statistics
OPEC Organisation of the Petroleum Exporting Countries
PGM Platinum Group Metals (platinum, palladium, rhodium, ruthenium, osmium, iridium)
PNAS Proceedings of the National Academy of Sciences of the United States of America
PwC PricewaterhouseCoopers
UNEP United Nations Environment Programme
UNESCO United Nations Educational, Scientific and Cultural Organisation
USGS United States Geological Survey

Technical Glossary

$ All dollar denominations in US dollars
b/d Barrels per day
GW Gigawatt
kWh Kilowatt hour
M3 Cubic metre
Mt Million tonnes
MW Megawatt
TOE Tons of Oil Equivalent
TWh Tera Watt hour (1 terawatt-hour per year = 114 megawatts)
USD/bbl US Dollars per barrel

DEFINITIONS

Metals and Minerals

A mineral is a naturally occurring solid chemical substance having characteristic chemical composition, highly ordered atomic structure, and specific physical properties. Minerals range in composition from pure elements and simple salts to very complex silicates with thousands of known forms. For the sake of simplification we will use the term "metal" for pure elements from the periodic table (e.g. gold - Au, copper - Cu, iron - Fe), and "mineral" for more complex structures containing two or more chemical elements.

Rare Earths

Rare Earth Elements (REEs) are a set of 17 chemical elements in the periodic table (scandium, yttrium, lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, luthertium). Despite their name, rare earth elements (with the exception of the radioactive promethium) are relatively plentiful in the Earth's crust. However, because of their geochemical properties, rare earth elements are typically dispersed and not often found in concentrated and "economically exploitable forms". The few more accessible deposits are known as rare earth minerals.

Exponential Growth

In approximate terms, a unit growing annually by x% will double its size in 70/x years. For instance China's economy, growing at rates close to 10%, will double its size in just 70/10=7 years.

Hydraulic Fracturing (Fracking)

This is the process used for extracting natural gas trapped in rock thousands of feet below the ground. A well is drilled into geologic formations, which contain large amounts of gas, in order to access previously unattainable resources. The well is cased with steel and concrete and then explosives are used to make perforations in the casing where the gas can be found. Fracking fluid, which is a mixture of water, sand and chemicals, is then injected into the well at a very high pressure causing the shale rock to fracture and releasing the gas.

Between 1 and 8 million gallons (4,000 - 35,000 cubic metres) of water are required every time a well is fracked and as many as 600 chemicals are found in the fracking fluid. The enormous quantity of water needed is either sourced nearby, which can deplete fresh water supplies, or is brought in by hundreds of trucks. Up to 70% of the non-biodegradable fracking fluids remain underground and the fluids that do return to the surface are usually stored in open pits or trucks close to the well. The toxic wastewater in open pits evaporates dispersing VOC's (volatile organic compounds) into the atmosphere. Methane gas and toxic chemicals can leach out during the fracking process and contaminate nearby groundwater. In several cases alarmingly high levels of methane have been found in drinking water in nearby towns or cities, leading to people being able to set their tap water on fire.

Mountain Top Removal Mining

Mountain Top removal mining (MTR), also referred to as valley fill coal mining, is a very destructive form of strip mining which actually removes the tops of mountains. Entire mountain ranges have been destroyed in some areas of the USA and yet this devastating form of mining is spreading. Firstly, forests are cut down which destroys all the vegetation and often strips away the top layer of soil. Explosives are used to blast as much as 800 feet off mountaintops and "fly rock" from these explosions can threaten nearby homes and residents. Huge shovels are used to dig up the soil after the explosions and the soil is then taken away by trucks or dumped into adjoining valleys. Next, the rock is dug into to uncover and remove the coal. When the coal is removed all of the "overburden" from the process is dumped into close by valleys, which creates valley fills. Once the companies have finished mining the mountain is left barren and flooding becomes common. Without the trees covering the mountains, torrents of rainwater flow off steep slopes endangering the communities who live below. Although there have been attempts to replant vegetation on the bare mountaintops, the mountains never fully recover.[1]

1 Mountain Justice website, http://mountainjustice.org/facts/steps.php

EXECUTIVE SUMMARY

MINING, OIL and GAS: the impact of these extractive industries has always raised serious social and environmental concerns. However, this report signals a wake-up call to the fact that, today, the scale, expansion and acceleration of these industries are far greater than most of us realise. We are no longer talking about isolated pockets of destruction and pollution. Nowadays, chances are that, no matter where you live on Earth, land acquisitions for mining, oil and gas might soon be at your door. This trend is now a major driver of land grabbing globally, and poses a significant threat to the world's indigenous communities, farmers and local food production systems, as well as to precious water, forests, biodiversity, critical ecosystems and climate change.

This report alerts global citizens to the dynamics in the extractive industries as a whole, and shows the alarming scale of this overall trend. Just as in the Greek myth, when Pandora opened the box and let out all the troubles known to mortals, so too this new wave of land grabbing for mining is leading to unimaginable destruction. If hope does remain, we must wake-up and act now.

The extent and the scale of the increase in extraction over the last 10 years is staggering. For example, iron ore production is up by 180%, cobalt by 165%, lithium by 125%, and coal by 44%. The increase in prospecting has also grown exponentially, which means this massive acceleration in extraction will continue if concessions are granted as freely as they are now.

The period between 2005-2010 has seen China's mining sector grow by nearly a third. In Peru, mining exports for 2011 have increased an astonishing one-third in one year. In South Africa meanwhile, a consortium of international investors has applied for the rights to drill for shale oil and gas for a section covering around 10% of the country's surface.

Across Latin America, Asia and Africa, more and more community lands, rivers and ecosystems are being despoiled, displaced and devoured by mining activities. Enormous industrial wastelands are created from vast open pit mines and mountain top removal; voracious use and poisoning of water systems; deforestation; contamination of precious topsoil; air pollution; acid leaching; cancer clusters - the catalogue of devastation is relentless and growing.

The rights of farming and indigenous communities are increasingly ignored in the race to grab land and water. Each wave of new extractive technologies requires ever more water to wrench the material from its source. The hunger for these materials is a growing threat to the necessities for life: water, fertile soil and food. The implications are obvious.

Mining does not only pose a challenge for the global South. The development of "fracking" - which involves the high-pressure injection of a toxic mix of chemicals into deposits of shale rock to release the natural gas trapped within - means that developers are now eager to target the large shale oil and gas deposits under North America and Europe. With the inherent difficulty of safely containing the water and chemicals that are injected into the ground, these toxic cocktails inevitably leach into aquifers and local water systems, and pollute them. In the UK, there are already several shale oil and gas applications pending, even though one developer recently admitted that two minor earthquakes in Lancashire were probably caused by its fracking operations.

This dramatic increase in the ambition, scope and devastation from the world's extractive industries comes as a result of a number of factors converging simultaneously. The rising prices of metals, minerals, oil and gas have acted as an incentive to exploit new territories and 'less pure' deposits. Technologies are becoming more sophisticated in order to extract materials from areas which were previously inaccessible, uneconomic, or designated as being of 'lower quality'. An overall trend is that deposits with the highest quality or concentration have already been used up. This means that extraction from less accessible deposits requires more removal of soil, sand and rock, and therefore the gouging out of increasingly larger areas of land and water, as seen with the vast Alberta Tar Sands in Canada.

On top of all of this, there has been a marked acceleration of global investments in extractive industries in the last 3 years. The 2008 collapse of financial markets has led hedge and pension fund investors increasingly to target metal, mineral, oil and gas commodities, and their associated financial derivatives, in order to recoup their losses and spread their risk. This has had the effect of further driving their extraction.

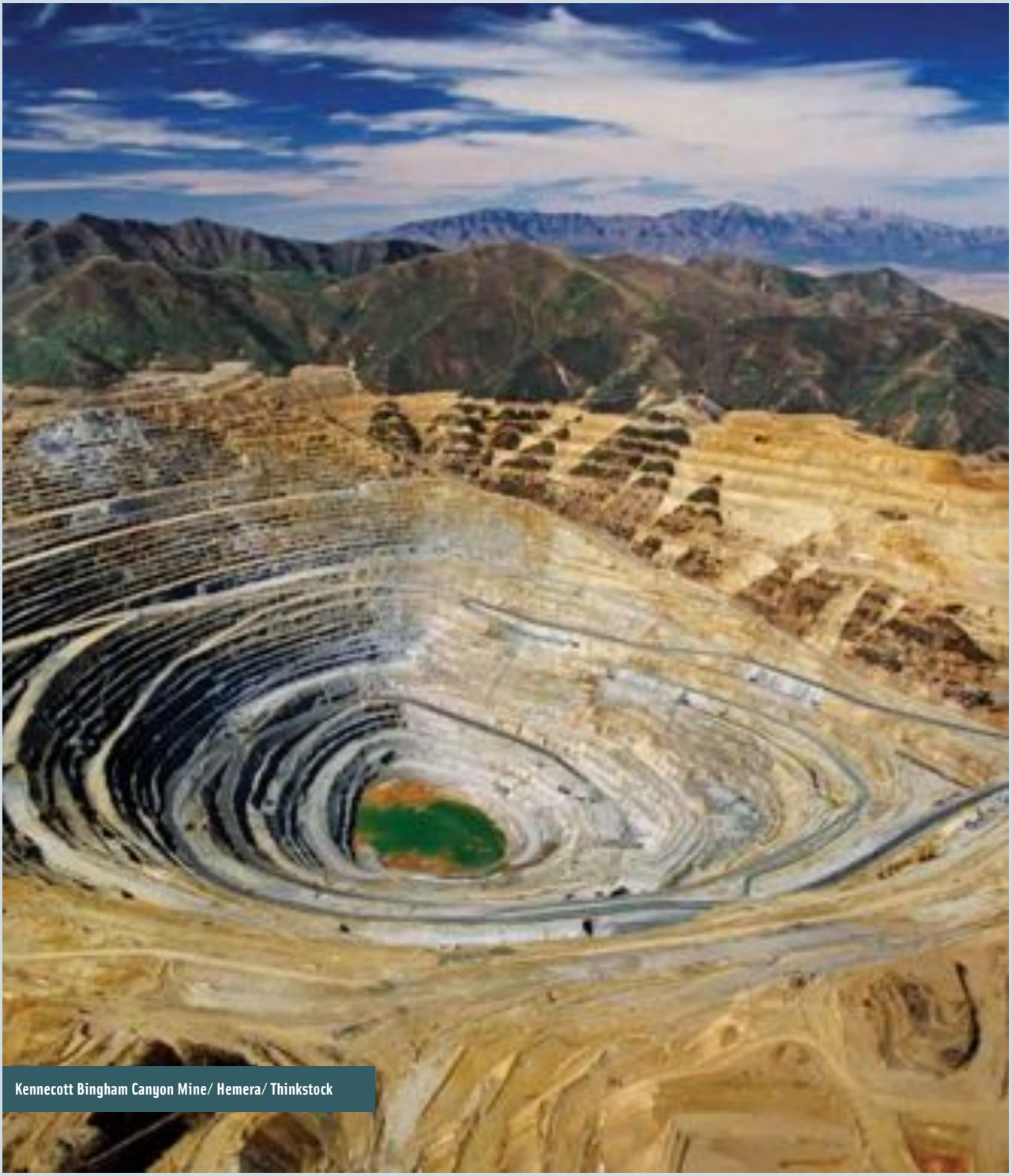
The underlying stimulus to all this, which governments and citizens have yet to adequately address, is the thorny issue of consumption. According to the Mineral Information Institute, the average American born today will use close to 1,343 metric tonnes of minerals, metals and fuels during his or her lifetime. This is more than 17 tonnes per person per year. The United Nations Environment Programme (UNEP) reports that a business-as-usual scenario would lead to a tripling in global annual resource extraction by 2050 – a scenario that the Earth simply cannot sustain.

There are no easy answers. The environmental impacts of fossil fuel extraction and combustion are well documented, while uranium mining and nuclear power are already fraught with controversy. And while many have pinned their hopes on the potential of "green energy" solutions, such as electric cars, solar panels and wind turbines, these also all require significant amounts of technology and minerals: rare earths primarily among them. As the use of green technologies scales up, inevitably, it too translates into a massive increase in yet more devastating mining activity.

As we know, the industrial economic model is premised on endless 'growth', defying the laws of life. Ultimately the options are brutally clear: either enough of us are able to turn the tide, based on an economic model that supports living processes, or we will be forced to do so, with much unnecessary suffering. Meanwhile,

there are currently few incentives or regulations to ensure the various actors in the production chain constrain the shameful waste and obsolescence. To re-use, recycle, design for recyclability or to develop the systems that use materials efficiently and economically, would at least close the cycle of waste and reduce our impact, some say by a significant amount.

We live on a beautiful and wondrous planet – the only one we know of in our cosmos. She suddenly feels very small and vulnerable in the face of the momentum of destruction we have unleashed on her, through our conscious and unconscious actions. We must recognise this reality: if we continue in our current direction, our children will be left to clean up an increasingly barren and unstable planet, littered with toxic wastelands and a huge scarcity of water, which we would have left in our wake.



Kennecott Bingham Canyon Mine/ Hemera/ Thinkstock

Venda, South Africa. Photograph by Philippa Terblanche

Venda, in Limpopo Province, South Africa. The Makhadzi are known as the "rainmakers" of South Africa, due to the capacity of their cultural rituals to invite rain to the area. For the people of Venda, practices such as these play a vital role in maintaining the health and integrity of their local ecosystems and of the wider community. The community's access to water is threatened by the Makhado Coking Coal Project. See Case study 4, p.26.

LAND GRABBING

Stopping land grabbing is not just about what is legal. It is about what is just.

On the 16th of November 2011, Cristian Ferreyra was shot dead by two masked men in front of his house and his family. Cristian lived in San Antonio, a village north of Santiago del Estero in Argentina. He was part of an indigenous community, and member of one of our partners, the indigenous peasant organisation MOCASE Via Campesina. His "crime"? To refuse to leave his homeland in order to make way for a massive soybean plantation, one of so many that have been encroaching on rural communities throughout Argentina in the last decade. So the plantation owners had him assassinated. Cristian was only 25 years old.

Gambela is a region in Ethiopia that borders South Sudan. It is home to one of the most extreme cases of land grabbing in the world. Over half of all the arable land in the region has been signed away to Indian, Saudi and other investors who are now busy moving the tractors in and moving the people out. Ethiopia is in the midst of a severe food crisis and is heavily dependent on food aid to feed its people. Yet, the government has already signed away about 10% of the country's entire agricultural area to foreign investors to produce commodities for the international market.

One could continue with many more examples of how people who just want to grow food and make a living from the land are being expelled, criminalised, and sometimes killed, to make room for the production of commodities and someone else's wealth.

Never before has so much money gone into the industrial food system. The last decade has witnessed a spectacular increase in speculation on the food commodity markets, sending up food prices everywhere. With today's global financial and economic crises, speculative capital is searching for safe places to multiply. Food and farmland are such places. "Everyone has to eat," is the new mantra preached in board-rooms. The race is on to take control over the world's food-producing resources - seeds, water and land - and the global distribution of food.

Money is also flowing directly into farming and land acquisition. Banks, investment houses and pension funds are actively buying up farmland all over the world. Most of this is happening in Africa, where people's customary rights to land are being grossly ignored.

This latest trend in global land grabbing - that for outsourced food production - is only one part of a larger attack on land, territories and resources. Land grabs for mining, tourism, biofuels, dam construction, infrastructure projects, timber and now carbon trading are all part of the same process, turning farmers into refugees on their own land.

Extracted from:

* GRAIN's acceptance speech for the Right Livelihood Award, 5 December 2011 http://www.grain.org

Hunger for oil, gas, minerals and metals - another dimension of land grabbing

Extractive industries represent another dimension of the same phenomenon - deals being done between hungry corporations and governments taking advantage of the enormous amounts of speculative capital looking for places to multiply. What is being grabbed is not only the land and the water from dispossessed local communities, but whole ecosystems are being violently destroyed by technologies of extraction which penetrate ever more deeply into the body of the Earth. Toxic chemical cocktails poison soil and water, far beyond the site of operation. The huge amounts of water required for these new technologies has led to mining of ancient aquifers in Australia, called cynically "new water".[1] This report exposes the dynamics of the growth in extractive industries and their impact on the Earth.

1 http://nonewcoal.greens.org.au/vital-water

"This latest trend in global land grabbing - that for outsourced food production - is only one part of a larger attack on land, territories and resources. Land grabs for mining, tourism, biofuels, dam construction, infrastructure projects, timber and now carbon trading are all part of the same process, turning communities into refugees on their own land. Living from the land is becoming more difficult and, in many parts of the world, more dangerous by the day."

Henk Hobbelink, GRAIN

Kennecott Bingham Canyon Mine

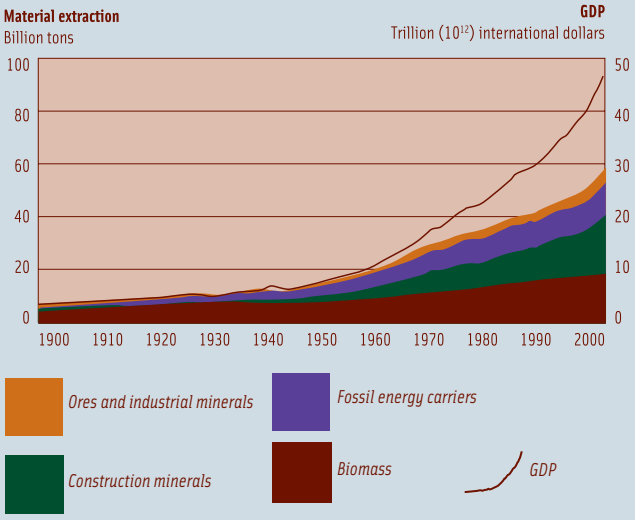
Kennecott Copper Mine is an open-pit mining operation extracting a large porphyry copper deposit southwest of Salt Lake City, Utah, in the Oquirrh Mountains, USA. It is the deepest open-pit mine in the world. The mine has been in production since 1906, and has resulted in the creation of a pit over 1.2 km deep, 4 km wide, and covering 7.7 km^2.

Open Pit Mine/Stockbyte/Thinkstock

INTRODUCTION

This year marks the tenth year since it all started to change. Energy and metal prices have reached record levels in the last decade, despite the 2008 financial crisis, Europe's sovereign debt crisis and China's economic slowdown. Economists talk of a third economic supercycle, after the first one in the late 19th century (US industrialisation), and the second one just after World War II (Europe's and Japan's reconstructions). Now it is the BRIC (Brazil, Russia, India, China) countries, China first among them, that lead the charge. In both previous cases these supercycles saw a rapid rise in the demand for raw materials, only to see an abrupt end to the cycle (firstly due to World War I and later to the 1973 oil shock respectively). Underlying these cycles, demand for raw materials has kept increasing throughout the 20th century. According to UNEP,[1] the annual extraction of construction materials in that time frame has grown by a factor of 34, ores and minerals by a factor of 27, fossil fuels by a factor of 12, biomass by a factor of 3.6, and total material extraction by a factor of about 8 while, simultaneously, GDP rose 23-fold. Yes, the economy is getting better at reducing the intensity use of materials, but the sheer increase in the absolute consumption of raw materials is staggering. Besides, consumption in the early part of the 20th century was overwhelmingly based on biomass, but the main materials now consumed are mineral - fossil fuels chief among them. In short, the composition of materials has shifted from renewable to non-renewable.

1.GLOBAL MATERIAL EXTRACTION IN BILLION TONS 1900-2005



Source: Krausmann et al., (2009) in: UNEP (2011) *Decoupling Natural Resource Use and Environmental Impacts from Economic Growth.*

1 UNEP (2011) *Decoupling Natural Resource Use and Environmental Impacts from Economic Growth*. URL: www.unep.org/resourcepanel/Portals/24102/PDFs/DecouplingENGSummary.pdf

Of all the materials used in the US in the 20th century, more than half were used in the last 25 years.[2] Yet, despite this big increase in demand, the overall trend has been (until 2001) a drop in the average real prices of most commodities, because of big improvements in productivity. There is a big BUT though: these productivity gains have never taken into account "external" costs, that is, the cost to the Earth and her inhabitants.

The loss of enormous amounts of topsoil, the extinction of countless habitats and species, the eviction of millions from their homelands to make way for large-scale extraction, the legacy of polluted rivers and acquifers, fields and air, the toxicity brought to the land, the enormous consumption of fresh water, the CO2 pumped into the atmosphere: this is the huge damage to the environment that will be with us for generations, if not forever. And yet it is not included in standard economic calculations. It is left as a debt for our children to pay.

According to TruCost,[3] a British consultancy, the environmental externalities of the world's top 3,000 listed companies total around $2.2 trillion annually. Lord Stern called it "the greatest market failure the world has ever seen".[4] But calling it a "market failure" is in fact part of the mindset that created the problem in the first place. As if the destruction of the Amazon forest could be commodified and given a financial value that should be weighed against the commercial gains obtained from this very destruction!

According to the Mineral Information Institute (MII), the average American born today will use close to 1,343 metric tonnes of minerals, metals and fuels during his or her lifetime.[5] This is more than 17 tonnes per person per year. In the UK, the Office for National Statistics (ONS) estimates the national total raw materials consumption at close to 2 billion tons per year.[6] This is equivalent to 30 tons per person, per year, and it does not even take into account the consumption of raw materials hidden in imported finished products. In India, despite recent annual growth rates of between 8 to 10%, the average is still about 4 tons per head, per year. As has been widely documented, if everyone on the planet was living the life of those in the West, we would need not one, not two, but between three and five planets (depending on one's income).

2 Matos, G. and Wagner, L. (1998) Consumption of Materials in the United States, 1900–1995: Annual Review of Energy and the Environment, p. 107. In: USGS (2002) Materials in the Economy Material Flows, Scarcity, and the Environment. URL: http://pubs.usgs.gov/circ/2002/c1221/c1221-508.pdf

3 TruCost (2011) Universal Ownership: Why Environmental Externalities *Matter to Institutional Investors*. URL: http://www.trucost.com/published-research/43/universal-ownership-why-environmental-externalities-matter-to-institutional-investors-full-report.

4 Stern, N. (2007) The Economics of Climate Change: The Stern Review. Cambridge University Press.

5 Mineral Information Institute. (2011) *Mineral baby*. URL: http://www.mii.org/MiiBabyMain.html

6 Office of National Statistics (2011) *Material flow accounts 1970-2009* URL: http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-224120

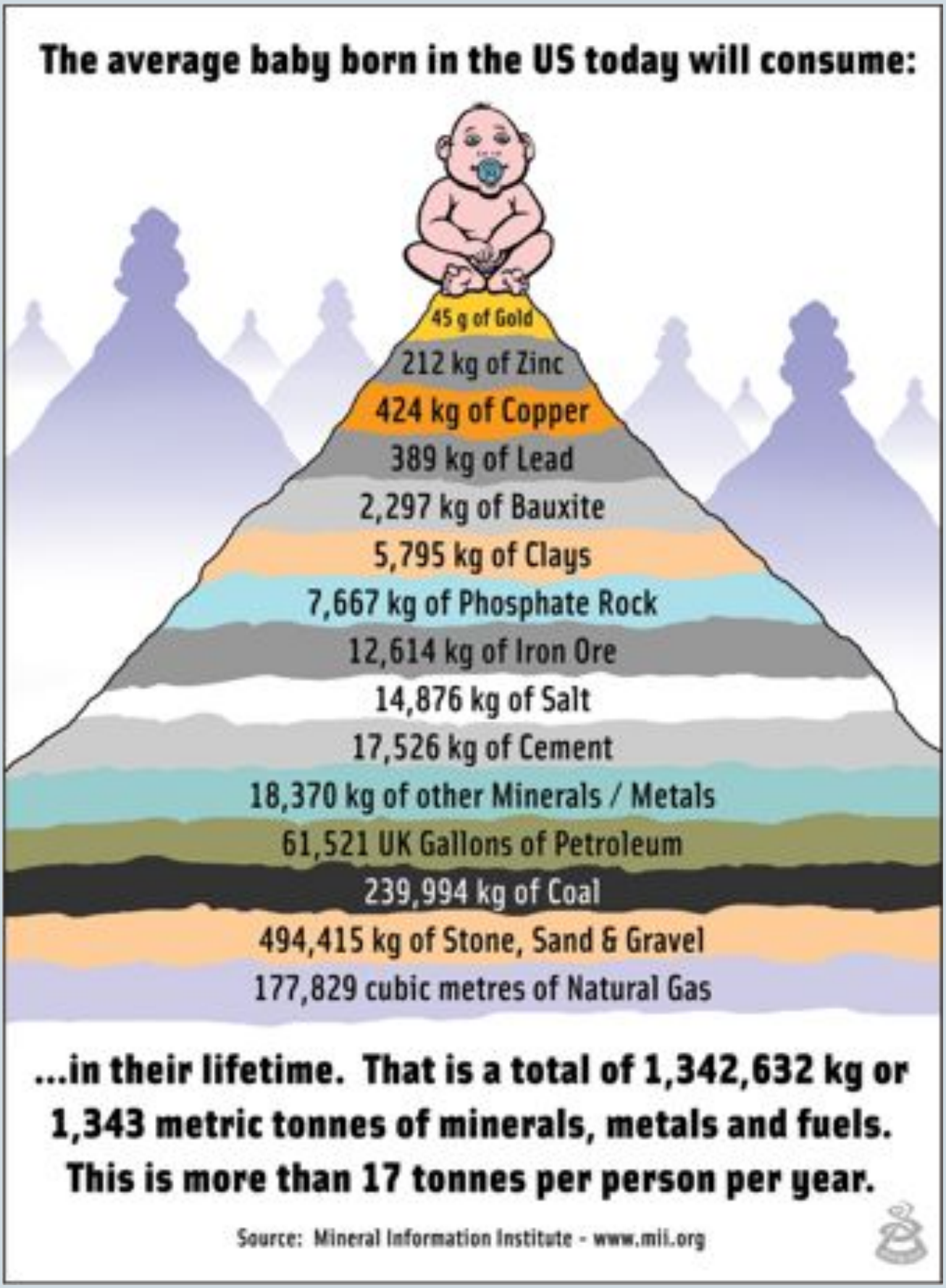

The average baby born in the US today will consume:
45 g of Gold
212 kg of Zinc
424 kg of Copper
389 kg of Lead
2,297 kg of Bauxite
5,795 kg of Clays
7,667 kg of Phosphate Rock
12,614 kg of Iron Ore
14,876 kg of Salt
17,526 kg of Cement
18,370 kg of other Minerals / Metals
61,521 UK Gallons of Petroleum
239,994 kg of Coal
494,415 kg of Stone, Sand & Gravel
177,829 cubic metres of Natural Gas
...in their lifetime. That is a total of 1,342,632 kg or 1,343 metric tonnes of minerals, metals and fuels. This is more than 17 tonnes per person per year.
Source: Mineral Information Institute - www.mii.org

fig.1

At a global level, we are already past the point of sustainability – the so-called "global overshoot". According to the European Environment Agency (EEA)[7] the global average ecological footprint (EF), a measure which translates consumption into direct and virtual land use, was estimated at 2.6 ha/person in 2006 compared to an average available global biocapacity of 1.8 ha/person. With the increase in the worldwide population (expected to reach 9 billion by 2050), the growing purchasing power of Asia and Africa's middle classes, the urbanisation of the world and the aspirations of billions to emulate a Western lifestyle, the demand for natural resources is now moving at breakneck speed. Going forward, the UNEP estimates that in a business-as-usual scenario, where industrialised countries maintain their per capita resource consumption and developing countries catch up with them, we will see a tripling of global annual resource extraction by 2050. A second possible scenario (one which we might term "moderate contraction and convergence"), where industrialised countries halve their per capita resource consumption and developing countries catch up with them (all of them reaching an average consumption of 8 tons/head/year), would lead to a 40% increase in resource extraction by 2050. To even envisage a third scenario of "tough contraction and convergence", where TOTAL global resource consumption is maintained at year 2000 levels (i.e. 50 billion tons), would require developed countries to reduce their resource use by a factor of 3 to 5, and for developing countries to exceed no more than 6 tons/head/capita.[8] But even such a far-reaching scenario would do no more than maintain resource consumption at year 2000 levels – a level which, as can already be seen across the globe, is not sustainable.

The task is indeed daunting. Mother Earth has never before in her history experienced such an assault. This is not the first time that commodities have been in demand, but never before has it been on such a scale. It now looks as if the 1990s were the last period of cheap raw resources. The turn of the century has seen the rise of the giants of Asia, and many more nations are now competing to access ever decreasing resources. This entails ever more aggressive strategies to locate and exploit, with terrible consequences not only at local but at global levels too.

Looking ahead, what does this mean for Earth and her inhabitants, human and non-human – rocks, soils, rivers, seas, animals, trees, plants? How can she ever cope with such an onslaught – while, as so many indigenous people have known since time immemorial, her loss is ultimately ours? The answer, as we know all too well, is that she cannot. We are now experiencing the 6th mass extinction of species,[9] on a scale and rapidity never seen before. It is also the first extinction in the Earth's history that has been brought about by one of Earth's own species. Ecosystems across the world are on the verge of collapse.[10]

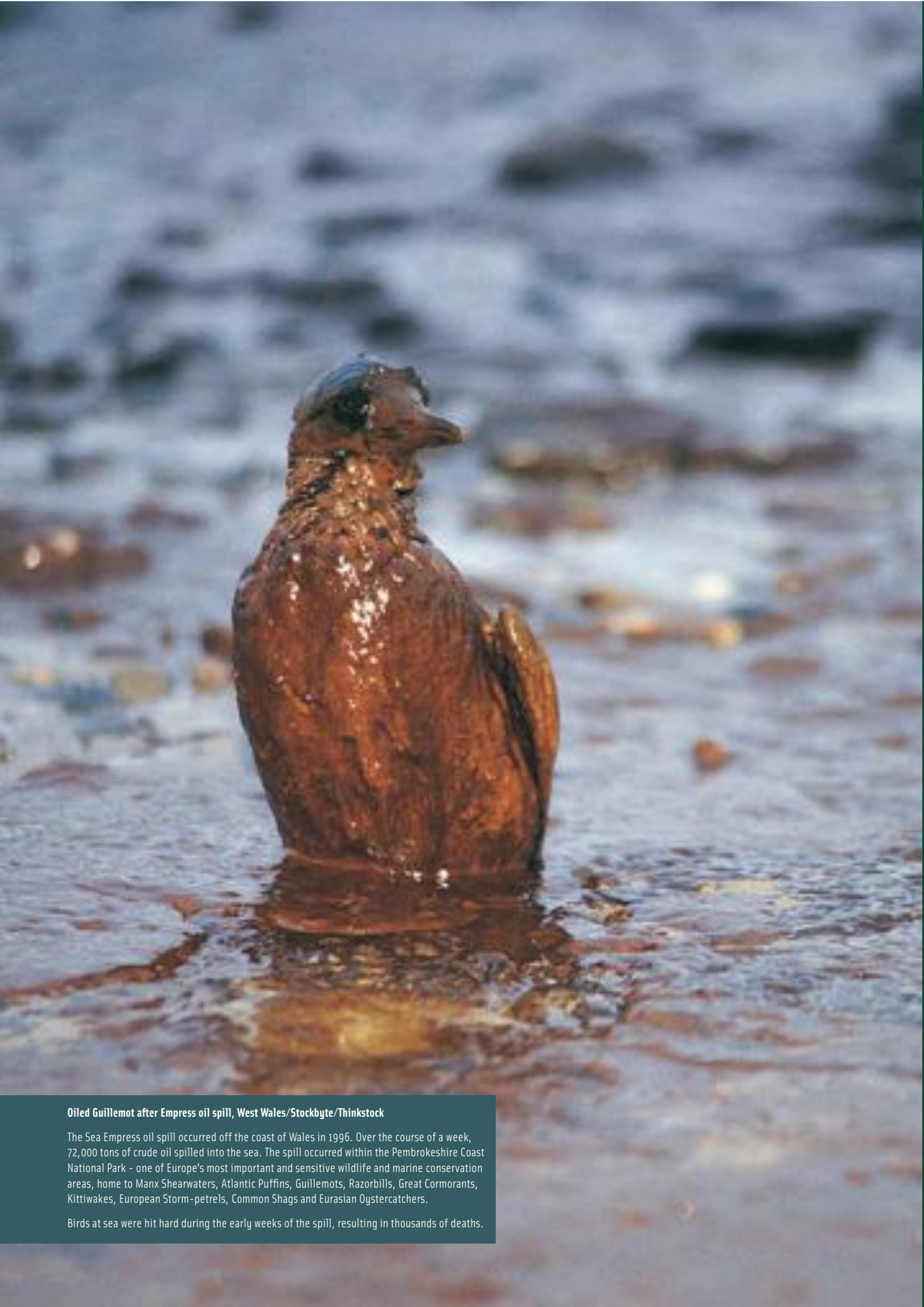
This report will look at the big picture, given today's parameters. That is, an economic model premised on 'growth', that some hope will one day be "sustainable", a population with increasing needs, and an urgent need to move away from releasing CO_2 in the atmosphere by developing 'green' alternatives. It is of course impossible to delve into the details – an encyclopaedia would not suffice. Nor is it the ambition of this report to come up with new information or solutions. Rather, our objective is to weave together what is known in order to present a picture of the scale and magnitude of the war we are consciously and unconsciously waging on Earth's fast diminishing 'resources'. And to try and read into the trends for what is to come if we do not take urgent action now to dramatically alleviate the strain we are putting on Mother Earth. While we lack foresight, and so any sense of due proportion, let alone respect and compassion, how could we know how much strain is too much? The precautionary principle is our most critical guide for action now. The aim of this report is to galvanise foresight and global action.

7 European Environment Agency (2010) The European Environment State and Outlook 2010: Consumption and the Environment. URL: www.eea.europa.eu/soer/europe/consumption-and-environment

8 UNEP (2011) Decoupling Natural Resource Use and Environmental Impacts from Economic Growth. URL: www.unep.org/resourcepanel/Portals/24102/PDFs/DecouplingENGSummary.pdf

9 Palaeontologists characterise mass extinctions as times when the Earth loses more than three-quarters of its species in a geologically short interval. Biologists now suggest that a sixth mass extinction may be under way, given the known species losses over the past few centuries and millennia. "*Has the Earth's sixth mass extinction arrived?*" Nature 471, 51-17 (03 March 2011),

10 *Living Beyond our Means: Natural Assets and Human Well-being*, Statement of the Millennium Assessment Board (2005).



Oiled Guillemot after Empress oil spill, West Wales/Stockbyte/Thinkstock

The Sea Empress oil spill occurred off the coast of Wales in 1996. Over the course of a week, 72,000 tons of crude oil spilled into the sea. The spill occurred within the Pembrokeshire Coast National Park - one of Europe's most important and sensitive wildlife and marine conservation areas, home to Manx Shearwaters, Atlantic Puffins, Guillemots, Razorbills, Great Cormorants, Kittiwakes, European Storm-petrels, Common Shags and Eurasian Oystercatchers.

Birds at sea were hit hard during the early weeks of the spill, resulting in thousands of deaths.

ENERGY

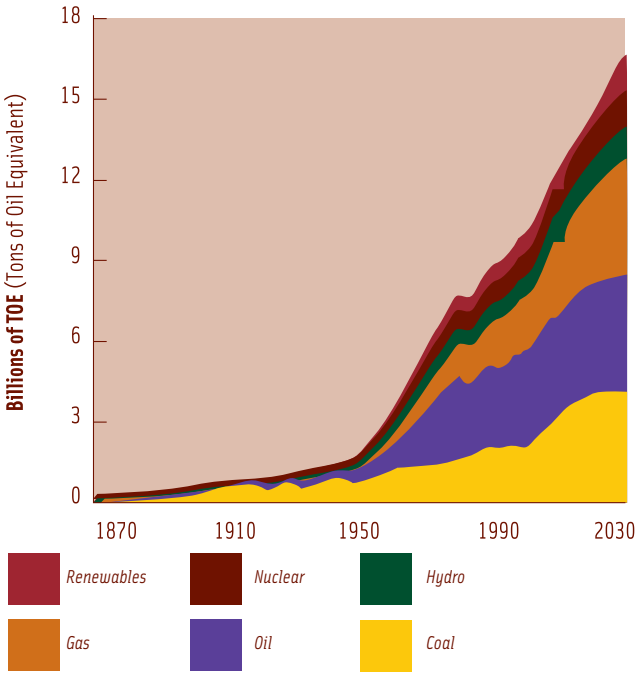
Trends in Consumption

The growth of energy demand in the world is a consequence of our current and future patterns of consumption, driven by the massive increase in the world population and by the average disposable income of that population.

As reported in 2011 by British Petroleum (BP) in its Energy Outlook 2030[1] the world population has quadrupled since 1900, real income has grown by a factor of 25 and primary energy consumption by a factor of 22.5. Furthermore, in the last twenty years the world's real income has increased by 87%, and is on course to increase by 100% in the next twenty years. Exxon estimates in its own Outlook[2] that global energy demand is expected to rise by 35% between 2005 and 2030, by which time it is expected to be six times the level in 1950. The graph below shows the projections of the world commercial energy use in billion tons of oil equivalent.

BP's Outlook report is based upon today's stated course of action by countries around the world: i.e., a global *status quo* with very little political will to address the current ecological crisis head-on. Barring a dramatic change in our patterns of consumption, here is what BP tells us we will see by 2030:

3.WORLD COMMERCIAL ENERGY USE



Source: BP (2011) *Energy Outlook 2030.*

- Fossil fuels will still be the main source of energy, with oil, coal and gas tending towards a share of about 26-27% each – so around 80% of our primary energy needs are supposedly still going to be met by fossil fuels in 2030. It was 88% in 1990 – a very paltry, dispiriting improvement in forty years.
- 93% of the increase in energy consumption in the next 20 years is expected to come from non-OECD countries, whose share of the total world consumption is expected to reach 66% vs 50% today, while it was 43% in 1990.
- Despite the fact that the carbon intensity of economic growth - i.e., the amount of CO_2 emitted per unit of GDP - will decrease with the introduction of greener energies and more efficient energy use, BP forecasts that worldwide CO_2 emissions will be 27% higher in 2030 than today.

Moreover, according to recent figures released by BP, worldwide GDP will grow by 3.7% every year over the next twenty years. This might not sound like much but exponential growth of this sort is indeed frightening: a 3.7% annual growth rate over twenty years means that the global economy will be twice as big in 2030 as it is today. How Mother Nature will cope is obviously not part of the equation.

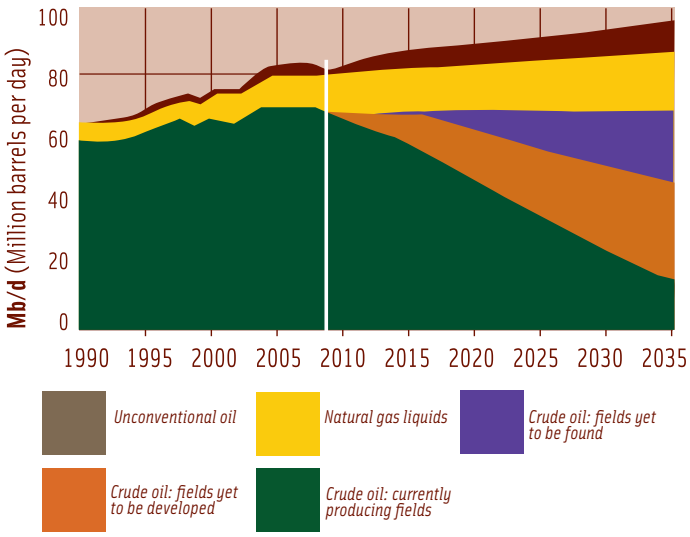
1 BP (2011) *Energy Outlook* 2030. URL: http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/2030_energy_outlook_booklet.pdf

2 Exxon Mobil (2010) *The Outlook for Energy: A View to 2030*. URL: www.exxonmobil.com/corporate/files/news_pub_eo_2010.pdf

"Colonisation is alive and well – it comes in the form of land-grabbing and the extractive industries. Corporations are stamping on the ground to get the oil because the world is so terribly addicted to crude oil. We have to break that addiction. Nothing is sacred when it comes to crude oil. The rights of Nature are swallowed up. It's time to leave new oil in the soil. If we carry on as we have been, we are digging a hole to bury the planet."

Nnimmo Bassey, Executive Director of Environmental Rights Action, and Chair of Friends of the Earth International

4.WORLD OIL PRODUCTION BY TYPE



IEA Projections - Global oil production reaches 96 mb/d in 2035 due to rising output of natural gas liquids and unconventional oil, as crude oil production declines.

Source: *IEA World Energy Outlook 2010*

Oil – Future or No Future?

With the production of conventional oil in decline, increasingly aggressive strategies are being pursued to find and develop non-conventional sources of oil (tar sands, shale oil, deep offshore, etc…) with terrible consequences for the ecosystems and communities.

The history of oil is closely associated with the history of 'modern' Western civilisation. Replacing coal as the dominant fuel in the 2nd half of the 19th century, oil has proven to be a reliable and cheap source of energy for more than a hundred years. Cheap, that is, if we do not take into account the massive ecological and social damage caused by its extraction and, even more so, by the legacy of billions of tons of CO2 released in the atmosphere for which we can barely glimpse the real price we will have to pay. Oil is now entering its terminal phase. On the one hand there is general recognition that it must quickly make way for cleaner, 'greener' alternatives – that is, alternatives emitting less CO2 than it does. On the other hand, resources are fast diminishing anyway and, coupled with increasing worldwide energy demand, oil as a major source of energy is fast approaching crunch time. This in theory should be good news – it would be much more difficult to get rid of our addiction if we had hundreds of years of reserves under our feet, accessible at a minimum cost.

Peak Oil?

Theories abound as to how much oil is actually still available in the ground. For political and commercial reasons, producing countries tend to overestimate their reserves, as do the major oil companies. According to the Industry Taskforce on Peak Oil and Energy Security (ITPOES),[3] there are currently 70,000 oil fields in production in the world but a mere 120 of them contribute 50% of the production and one field alone, the super giant Ghawar field in Saudi Arabia, contributes 5% of the total. No major field has been discovered in the last 30 years. Serious prospects can be found in Iraq and the Caspian Sea, but the global yearly rate of depletion of oil fields is about 4 million barrels per day (b/d) while world demand increased 2.8 million b/d in 2010, the 2nd highest increase in 30 years, to reach 87.8 million b/d. The International Energy Agency (IEA) recently said the world needed to find the equivalent of 4 Saudi Arabias in the next 20 years even to hope to sustain current production. Meanwhile Saudi Arabia itself might use all its current production by 2030, more than 8 million b/d, to feed its own requirements. Demand for electricity in Saudi Arabia is increasing by 8% a year (in effect, doubling total consumption every 8.75 years). Remarkably, the IEA itself implicitly acknowledged that peak oil was upon us, as shown on the left by this graph from the Energy Outlook 2010 report.

3 ITPOES (2010) *The Oil Crunch: A Wake-up Call for the UK Economy*. URL: http://peakoiltaskforce.net/wp-content/uploads/2010/02/final-report-uk-itpoes_report_the-oil-crunch_feb20101.pdf

Case Study 1:

Nigeria - Niger Delta Communities say 'Leave Oil in the Soil'!

"People are born into pollution, they live in pollution, and they are buried in pollution."

Nnimmo Bassey, Executive Director of Environmental Rights Action, and Chair of Friends of the Earth International.

Shell oil spill at Goi, Niger Delta. Photograph by Alison Dilworth/Friends of The Earth.

Ogoni land, in the vast Niger Delta, is the ancestral home of communities who have lived there for centuries. To the Ogoni people their land is sacred and the souls of humans and animals are intertwined. Rituals, often with yam, are performed to honour the land and give thanks for its rich gifts of abundant food and water.[1] Ogoniland was the home of Ken Saro-Wiwa, a human rights and environmental activist, who campaigned to protect his peoples' beautiful delta from the violations of the oil industry, until he was assassinated in 1995.

This was one of the many reactions to the fact that in 1993, the Ogoni people united and expelled Shell Oil from Ogoni land. Environmental Rights Action (ERA) (Friends of the Earth Nigeria) work with the Ogoni to help them deal with the devastating impact which Shell Oil continues to have on their homeland and communities. It is hard to imagine, but when people visit the area they leave deeply shocked and outraged. For example, there were two major oil spills in 2008 and 2009, which continued unabated for months. The local community were forced to abandon their traditional ways of farming and fishing as the thick oil killed the plant life and the rivers, suffocating the fish and caking the birds and animals in oil. An average of 2 oil spills are recorded EVERYDAY in Nigeria, so this is also a reality for many other communities in Nigeria.

Gas flaring is another major challenge in Nigeria, which is having devastating implications locally and globally. The burning off of associated gas from crude oil extraction is contributing to acid rain, desertification and drying up of rivers such as Lake Chad, and to global warming. These conditions are forcing pastoralists and fishermen to migrate as environmental refugees, which increases pressure on land elsewhere. Diseases, such as bronchitis, from fumes of the gas flaring, are also rife.

In 2011 the United Nations Environment Program (UNEP) Report on their assessment of the environment of Ogoni land confirmed the concerns and claims of the Ogoni people. The Report found that, in over 40 locations tested, the soil is polluted with hydrocarbons up to a depth of 5 metres. Further, that all the water bodies in Ogoni land are polluted. UNEP also reported that the levels of benzene (a chemical known to cause cancer) in approximately 90 of the locations, is more than 900 times above accepted World Health Organisation standards. Yet this contaminated water is the source of drinking water for local communities. The UNEP estimated that it would take 35 years to clean up Ogoni land and water systems, and an estimated one billion US dollars to begin the clean up.

As Nnimmo Bassey (Executive Director of Environmental Rights Action, and Chair of Friends of the Earth International) highlights: "The figure in this report assumes all the funding comes in and the conditions exist to use them effectively. We have estimated that it will take between 300-500 billion dollars to clean the entire Niger Delta, and almost a lifetime to restore Ogoni land."

ERA has been supporting local communities in their call for 'leaving oil in the soil', and they have presented a proposal to the Nigerian government for no new oil fields. ERA have been involved in numerous campaigns and lawsuits to hold corporations to account, including the 2005 landmark ruling by a Nigerian High Court that gas flaring is unconstitutional, damages people and the environment, and must stop. Recently, the Bodo community filed a case in the High Court in London to sue Shell for damages to their ecosystems and community, and, in 2011, Shell admitted liability. However the struggle to stop oil spills continues – in December 2011 Shell spilled nearly 2m gallons of oil off the coast of Bonga, Nigeria, in the worst spill in Nigeria in 13 years.[2]

For more information:

- *Environment Rights Action – http://www.eraction.org*
- *See field studies and testimonials from communities - http://www.eraction.org/component/eracontent/?view=categories&id=2*
- *Unrepresented Nations and Peoples Organisation - http://www.unpo.org/members/7901*

1 For more information see Unrepresented Nations and Peoples Organisation http://www.unpo.org/members/7901

2 Michael Keating *(2010) 'Nigeria's oil disasters are met with silence'*, The Guardian, *9 January, 2012.* URL *http://www.guardian.co.uk/commentisfree/2012/jan/09/nigeria-oil-disaster-silence?INTCMP=ILCNETTXT3487*

Case Study 2:

Tar Sands in Alberta, Canada – 'The most destructive project on Earth'

"I understand there has to be progress. I understand they want markets outside of Canada, to Asia. But at the same time, how do we balance this with taking care of our Mother Earth? In my opinion, she is in pain now."

*Driftpile First Nation Chief Rose Laboucan **

Alberta Oilsands/iStockphoto/Thinkstock

The Boreal forests in Alberta, Canada, are a unique and fragile ecosystem which is home to diverse cultures of the First Nation peoples. Their traditions have adapted to this complex landscape over centuries.

Today the landscape is scarred by Tar Sands Extraction which has become known as "the most destructive project on Earth".[1] The scale is so enormous that the wound can be seen from space. The oil embedded in the sand lies under 140,000 km2 of forests, equivalent to the size of England.[2] The Tar Sands process emits as much as four times more carbon dioxide than conventional drilling. There is rapid deforestation as trees are cut down and the top layer of peat is removed to reveal the oil sands. Four barrels of water, energy equal to three barrels of oil, and four tons of earth are required to extract one barrel of oil.[3]

The extraction process contaminates the water and creates enormous toxic tailing ponds. It is estimated that thousands of migratory birds die every year when they land on the oily toxic surfaces, many more than the industry is reporting. First Nations communities living close to the oil sands or downstream on the Athabasca River, are suffering from higher-than-normal cancer levels and illness.[4]

Warner Nazile, an activist from British Columbia and member of the Wet'suwet'en First Nation, said: "It's literally a toxic wasteland—bare ground and black ponds and lakes—tailings ponds—with an awful smell."[5]

In January 2012, there was hope when the Obama administration rejected an application from a Canadian firm to build the Keystone XL pipeline, stretching 1,700 miles from the Alberta Tar Sands to Texas. However, this does not guarantee that the pipeline will never be built and the struggle to stop new pipelines is not over. First Nations communities are fiercely contesting another planned pipeline, Enbridge's Northern Gateway. 730 miles of pipeline would carry 525,000 crude barrels from the Tar Sands daily to Kitimat on the British Columbian coast, to be shipped to Asia. The pipeline's path is across pristine lakes, mountains and First Nations territory. It is supported by the Canadian government due to the large revenue it will generate.[6] No First Nations in British Columbia have endorsed the pipeline. They fear that inevitable oil spills from the pipeline will leave permanent scars on their ancestral lands which they have a duty to protect for the next generation.

Tar Sands exemplifies the scale and the long-term destruction caused by the new generation of extractive technologies. This permanent damage to huge ecosystems is increasingly understood as 'Ecocide'- a crime against an ecosystem and all the communities who depend on it.

For more information:

- *Tar Sands UK Network - http://www.no-tar-sands.org/what-are-the-tar-sands/*
- *Eradicating Ecocide - http://www.eradicatingecocide.com/*

* Cited in Hoekstra, G. (2012) 'First nations fiercely opposed to Northern Gateway', Vancouver Sun, 3 January 2012, http://www.vancouversun.com/news/First+nations+fiercely+opposed+Northern+Gateway/5937416/story.html (accessed on 6 February 2012).

1 Hatch, C. and Price, M. (2008) Canada's Toxic Tar Sands: The Most Destructive Project on Earth. Environmental Defence Publication, February 2008. http://environmentaldefence.ca/sites/default/files/report_files/TarSands_TheReport.pdf (accessed on 9 February 2012).

2 See here: http://www.no-tar-sands.org/what-are-the-tar-sands/ (accessed on 9 February 2012).

3 All Against the Haul (2012) 'The most destructive project on earth' Online: http://allagainstthehaul.org/the-haul/the-heavy-haul/the-alberta-tar-sands/ (accessed on 6 February 2012).

4 Berry, C. (2012) 'Alberta Oil Sands Up Close: Gunshots Sounds, Dead Birds, a Moonscape', Indian Country Today Media Network, 2 February 2012, http://indiancountrytodaymedianetwork.com/2012/02/02/alberta-oil-sands-up-close-gunshot-sounds-dead-birds-a-moonscape-95444#ixzz1lF5gtXTJ (accessed on 6 February 2012).

5 Ibid.

6 Ibid.

As is clearly illustrated, even with the addition of "fields yet to be found", conventional crude oil production peaks in 2015. This means we must now rely on "unconventional" oil – expensive, elusive and dirtier to extract. The extraction of these elusive deposits have far greater impacts on ecosystems and communities because of the pervasive technologies, toxic chemicals and the huge amounts of water used to extract these less accessible deposits.

This all serves to highlight that energy conservation has never been so urgent. Another study, this time led by Sir David King, former Chief Scientific Advisor to the UK Government, and by researchers from Oxford University, claimed that oil reserves had been exaggerated by a third, mainly by OPEC.[4] Their own research estimated reserves at 850-900 billion barrels, not the 1,150-1,350 billion barrels officially claimed by oil producers and accepted by the IEA. They anticipated that demand could outstrip supply by 2014-2015.

But far from relegating oil to the backburner in order to swiftly get rid of our dependence, these dynamics have in fact two major consequences: a rearguard action by oil companies, minimising or denying the links between fossil fuels and climate change while aggressively trying to find new deposits; and the end of (very) cheap oil.[5]

New Oil?

As discussed, big discoveries of conventional oil are now few and far between. Besides, the geopolitical landscape of oil has changed a lot in the last few decades. While the original major oil companies, known as the 'seven sisters', were dominant in the 1960s, the pendulum has since then swung back firmly in favour of national state oil companies. According to BP, just 9% of reserves are outside the grip of national companies, compared with 90% thirty years ago. OPEC's share of the oil market will inevitably increase in the years to come. If any major conventional discovery remains to be made, it will most likely not be made by an international major oil company, whose future prospects have dramatically shrunk. As a result, oil companies now venture into more and more difficult areas in order to find new deposits. These areas require expertise, capital and risk-taking, while at the same time being ever more devastating for the environment. Among the new "strategies of development":

- **Deep offshore** *exploration, which has accounted for approximately 50% of all global discoveries since 2006. Brazil is the leader in the field.*
- **New geographical frontiers***: Arctic, East Africa. As Bob Dudley, BP Chief Executive, puts it: the Arctic is "one of the world's last remaining unexplored basins".*
- **Tar sands***: Canada, Venezuela. Four tons of sand and five barrels of water are necessary to produce just one barrel of oil while the whole operation is estimated to generate three to five times as much CO2 as conventional oil extraction.*[6]
- **Pre-salt reservoirs***: Brazil. The total depth of these rocks, i.e. the distance between the surface of the sea and the oil reservoirs under the salt layer, can be as much as 7,000 metres.*
- **Shale oil:** *mainly USA for now, but seen as a game-changer for the US oil industry. See chapter on shale gas for the description of the highly damaging fracking technique used to access these deposits.*

New Price?

Looking at the big picture, a shift seems to have taken place at the turn of the century from a supply-driven price (wars affecting supply or over-supply depressing prices, as in the mid-1980s) to a demand-driven price. This is corroborated both by the emergence of China and India in the last ten years, pushing demand sharply up (as discussed earlier), and by the lack of major discoveries, putting a cap on the oil on offer. In short, the oil market supply and demand has tightened up since 2000, bringing added volatility to the price.

As previously mentioned, the cheap sources of oil are basically finished. The ITPOES report ranks extraction costs as follows: Saudi Arabia 20 usd/bbl, Other Middle East 25 to 30 usd/bbl, Other OPEC low 30s, Russia 35 usd/bbl, non-OPEC (conventional oil) 50 to 60 usd/bbl, deep offshore 65 to 75 usd/bbl, Canadian tar sands 85 to 95 usd/bbl. Iraq is the last country with low costs of extraction in a position to significantly increase its production (estimation: +4 to 5 million b/d). Saudi Arabia has a current spare capacity of close to 3.5 million b/d, assuming it can indeed produce 12.5 million b/d, but its potential to go much beyond that for any length of time is seriously in doubt. Even more importantly, the International Monetary Fund (IMF) has recently estimated[7] that the "break-even oil prices" – i.e. the price at which the Middle East oil producers balance their budgets given their level of expenditure and non-oil revenues – has risen to 80 usd/bbl for Saudi Arabia from 60 usd/bbl three years ago and 30 usd/bbl ten years ago. This basically means that incremental barrels needed to supply the world will come from expensive sources.

Once again, given the urgent need to move away from oil anyway, because of its carbon impact, this should be seen as another reason to move away swiftly to other, cleaner sources of energy and energy conservation. But we just can't, or won't, shake off our lethargy, and the uncertainty now prevailing on oil is also helping the cause of climate change's biggest nemesis: coal.

They Call it King Coal

Mining coal is widely recognised as the most damaging form of mining, on both the ecosystems and on communities. The burning of coal is also the biggest emitter of CO2 into the atmosphere;

4 Mason, R. (2010) 'Oil Reserves "Exaggerated by One Third"'. *The Daily Telegraph*. 22 March, 2011. URL: www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/7500669/Oil-reserves-exaggerated-by-one-third.html

5 Greenpeace (2010) *Who's Holding Us Back? How Carbon-Intensive Industry is Preventing Effective Climate Change Legislation*. URL: www.greenpeace.org/international/en/publications/reports/Whos-holding-us-back

6 Source: www.no-tar-sands.org

7 International Monetary Fund (2011) *World Economic and Financial Surveys, Regional Economic Outlook: Middle East and Central Asia*. URL: http://www.imf.org/external/pubs/ft/reo/2011/mcd/eng/pdf/mreo1011.pdf

more than any other fossil fuel. And yet, the consumption of coal is projected to increase by 50% in the next twenty years.

Coal is different from oil in two major ways: it is widely geographically distributed, with fewer geopolitical considerations to consider, and it has bigger reserves – more than 100 years at current consumption rates (although it is less than that if we account for increasing consumption). However it is also much less versatile than oil. Its two main uses are for electricity generation (thermal coal, burned to create steam to propel turbines) and for manufacturing steel and cement (coking coal, aka metallurgical coal), with thermal coal representing 70% of the total production. Coal can also be turned into a liquid fuel (coal liquefaction). South Africa, poor in oil but rich in coal and anxious to develop its own fuels when it was facing isolation during the apartheid years, has been at the forefront of the CTL (coal-to-liquid) technology since 1955, its strategic value more than making up for its high cost.

The environmental legacy of coal is terrible but, as is the case for oil, mainstream economics blindly refuses to acknowledge the true cost of coal's extraction and use. A new report by the New York Academy of Sciences[8] is damning in its assessment: "*Each stage in the life cycle of coal – extraction, transport, processing, and combustion – generates a waste stream and carries multiple hazards for health and the environment. These costs are external to the coal industry and are thus often considered 'externalities' We estimate that the life cycle effects of coal and the waste stream generated are costing the US public a third to over one-half of a trillion dollars annually. Many of these so-called externalities are, moreover, cumulative. Accounting for the damages conservatively doubles to triples the price of electricity from coal per kWh generated, making wind, solar, and other forms of non fossil fuel power generation, along with investments in efficiency and electricity conservation methods, economically competitive*".

Each year a typical 500MW coal-fired power plant emits 10,000 tons of sulphur dioxide (SO2), 10,200 tons of nitrogen oxide (NOx), 500 tons of particulate matter, 120,000 tons of ash, 193,000 tons of sludge and 3.7 million tons of carbon dioxide (CO2) along with many other toxins.[9] Coal produces one and a half times the CO2 emissions of oil and twice as many as natural gas. Coal burning accounts for 40% of worldwide electricity but also 72% of CO2 emissions generated by power stations. If we include coal's other uses, mainly industrial and residential, coal represents 25% of total energy consumption but is responsible for 41% of worldwide CO2 emissions.

As reported by the NY Academy of Sciences (*ibid.*) the catalogue of coal's impact on health and the environment makes for a grim reading:

- **Underground mining** - *occupational injuries, diseases, chronic illnesses and deaths.*
- **Mountain Top Removal** *(MTR) - to expose coal seams, forests are removed and rocks fragmented with explosives. The rubble or "spoils" then sit precariously along edges and are dumped in the valleys below.*
- **Coal Combustion Waste (CCW) or fly ash** - *contains toxic chemicals and heavy metals; pollutants known to cause cancer, birth defects, reproductive disorders, neurological damage, learning disabilities, kidney disease and diabetes.*
- **Methane** - *emitted during coal mining, methane is a greenhouse gas 25 times more potent than CO2 in a 100-year life cycle.*
- **Impoundments** - *found at the periphery and at multiple levels at Mountain Top Removal (MTR) sites, adjacent to coal processing plants, and as coal combustion waste ("fly ash") adjacent to coal-fired plants.*
- **Slurry from processing plants** – *a toxic by-product from the cleaning-up of coal to remove impurities and heavy metals to prepare it for combustion.*
- **Water contamination** - *chemicals in the waste streams include ammonia, sulphur, sulphates, nitrates, nitric acid, tars, oil, fluorides, and other acids and metals such as sodium, iron, cyanide plus additional unlisted chemicals.*
- **Carcinogenic emission**s - *most of them emitted into water, mainly consisting of cadmium and arsenic.*
- **Community health impacts** - *lung cancers and heart, respiratory and kidney diseases.*
- **Ecological impacts** - *imperilled aquatic ecosystems, harmful algal blooms, long-range air pollutants, loss of air quality, atmospheric nitrogen deposition, acid rain, release of mercury in the environment.*
- **Contribution to climate change** - *increased release of CO2 and methane in the atmosphere.*

This should be compelling enough to try and stay away from coal as much as possible. However, this is not the route that governments across the world are taking. Carbon Capture and Storage (CSS) technology is now high up on the agenda of the coal industry and is being aggressively promoted by both the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) as an essential component in the fight to reduce CO2 emissions in the atmosphere. In its 2009 CCS Technology Roadmap,[10] the IEA estimated that CCS will achieve up to 20% of the reduction in CO2 emissions required by 2050, which will also mean trapping and storing a volume of CO2 equivalent to twice the volume of oil and gas the world currently extracts each year. But is this too good to be true?

For one, the technology itself is not yet commercially or technically proven on a large scale. The race is on to prove the concept but by some estimates it will not be ready for at least 10 to 15 years. So far, 80 large-scale industrial projects in various stages of development have been initiated around the world, with the US, the EU, Canada and Australia, among others, having invested $26 billion up to 2010. Meanwhile, a number of voices have expressed

8 New York Academy of Sciences (2011) 'Full Cost Accounting for the Life Cycle of Coal' *Annals of the New York Academy of Sciences. Ecological Economics Reviews*. v.1219, pp.73–98, February 2011.

9 Sourcewatch (2011) *The Environmental Impacts of Coal*. URL: http://www.sourcewatch.org/index.php?title=Environmental_impacts_of_coal

10 IEA (2009) *Technology Roadmap: Carbon Capture and Storage*. URL: www.iea.org/papers/2009/CCS_Roadmap.pdf

Case Study 3:

Mountain Top Removal Mining for Coal in Appalachia, USA - Wounds that never Heal

Mountaintop Removal in Raleigh County, West Virgina. Photograph by Vivian Stockman

Mountain Top Removal (MTR) mining is also referred to as Valley Fill Coal Mining. It is a very destructive form of strip mining which actually removes the tops of mountains.

Entire mountain ranges have been destroyed in some areas of the USA and yet this devastating form of mining is spreading. Firstly, forests and all the vegetation is clear cut and destroyed and the top soil is striped away. Explosives are used to blast as much as 800 feet of mountaintop, and "fly rock" from these explosions threaten nearby homes and residents. Huge machines are used to dig up the soil after the explosions and the soil is then taken away by trucks to be dumped into adjoining valleys. Next, the rock is gouged out to uncover and remove the coal. When the coal is removed all of the "overburden" from the process is dumped into close-by valleys, which fills up whole valleys.

Once the company has finished mining, the mountain is left barren and flooding becomes a problem. Without the trees covering the mountains, torrents of rainwater flow off steep slopes, endangering the communities who live below. Although there have been attempts to replant vegetation on the bare mountaintops, the mountains never fully recover.

Rob Goodwin from Coal River Mountain Watch, describes the impact of Mountain Top Removal mining in southern West Virginia:

"There were glaciers that covered much of the mountainous eastern US, but Southern Appalachia is unique. Because there were no glaciers here, the topsoil is some of the oldest in the world and that's why there are ramps, ginseng and molly moochers among other valuable species. What you are doing here on this mine site is destroying the 10,000 year-old species that, regardless of what you do, will not grow back. Even if you wait 10,000 more years, there is no guarantee it will ever be like it was. People in the community are concerned because they have thrived off harvesting these species for generations and now they are being destroyed. This destruction, combined with a lack of access to the mountain due to security, blasting, and active mining is a huge concern of the community."[1]

1 Goodwin, R. (2011) 'Report from Citizens' Inspection of Coal River Mountain', Coal River Mountain Watch, http://www.crmw.net/crmw/content/report-citizens-inspection-coal-river-mountain (accessed on 14 February 2012).

deep concern about devoting so many resources and energy to CCS. The objections and concerns are of several orders:

- *Costs.*
- *Pollution - CCS is meant to address the release of CO2 at the point of combustion. However CO2 will still be released during extraction and transportation to the point of combustion, while all the other types of pollution already described earlier are still prevalent*
- *Storage risks.*
- *Energy consumption - CCS wastes energy as it uses between 10 to 40% of the energy produced by a power station, thereby erasing the efficiency gains of the last 50 years and increase resource consumption by one third. Power stations with CCS not only require more energy, but will also need 90% more freshwater than those without.*[11]

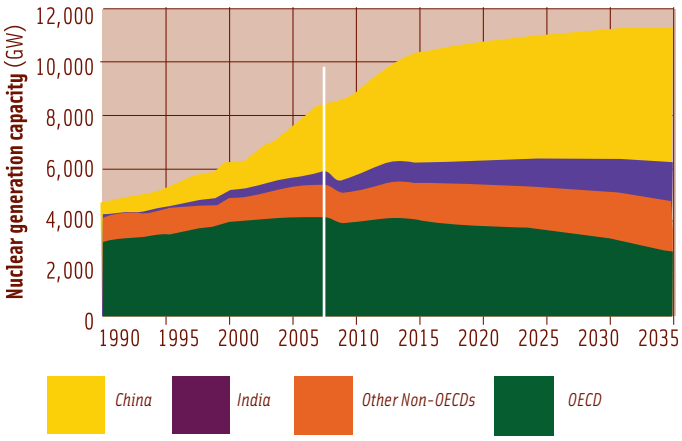
11 ISIS (2008) *Carbon Capture and Storage: A False Solution*. See here: http://www.i-sis.org.uk/CCSAFalseSolution.php

The issue of water in coal mining is already wreaking havoc – and CSS will make the problem even worse. Not to mention the twisted logic of fighting one aspect of coal (CO2 release) with more coal (and ignoring all other negatives of its extraction).

Carbon Capture Storage or Not, Coal Demand is Increasing

"Globally, coal remains the leading source of electricity generation until 2035, although its share of electricity generation declines from 41% to 32%. A big increase of non-OECD coal-fired generation is partially offset by a fall on OECD countries." This statement from the IEA World Energy Outlook 2010 sums it up, as does this graph from the same source, showing the evolution of coal-fired electricity generation:

5.COAL-FIRED ELECTRICITY GENERATION BY REGION



A drop in coal-fired generation in the OECD countries is offset by vast increases in other regions, especially China. **Source:** *IEA World Energy Outlook 2010.*

The story of coal in the years to come will essentially take place in Asia. For the first time, China became a net coal importer in 2009 of both thermal and coking qualities. It is now estimated that 90% of the increase in worldwide coal consumption in the next 20 years will come from Asia, with strong demand expected in China, India, South Korea and Taiwan. Even Vietnam, facing rapid urbanisation and industrialisation, is on course to import as much as 100 million tons by 2020. Going forward, mature economies are moving away from coal, in particular towards natural gas, while developing economies are basically putting their hands on every form of energy they possibly can to sustain their economic growth. In this respect coal, as seen earlier, is among the easiest routes forward due to its prevalence and relatively cheap price. Natural gas is the obvious candidate in a strategy of short-term mitigation but it has its dark side too.

Natural Gas – the Fuel of "No Choice"

The development of "fracking" techniques to access gas trapped in shale formations is a game-changer for the industry and is giving a new lease of life to fossil fuels. The impact of fracking on ecosystems is the subject of heated debate, with local residents endlessly reporting widespread water contamination by chemicals and methane, and even incidences of earthquakes (See fig.2).

Natural Gas accounts for 25% of global primary energy, while oil's share is 35% and coal's 30%. Other energies such as nuclear and renewables, make the last 10%. Put another way, 90% of the world's primary energy comes from fossil fuels. BP forecasts a convergence of the three fossil fuels towards a market share of about 26-27% each in 2030 while non-fossil fuels will reach a share of about 7% each. This would still leave a collective share of close to 80% for fossil fuels, way too much to have any influence on reducing our carbon emissions. Natural gas is expected to be the fastest growing fossil fuel to 2030.

The IEA estimates that by 2035, the global consumption of natural gas will reach 4.5 trillion cubic metres (m3), an increase of 1.4 trillion m3 on 2008 figures, for an average increase of 1.4% per year. China, currently a very low user of gas (which represents less than 4% of its primary energy), will see an annual consumption rise of 6% and will account for one fifth of the increase in global demand. The share of natural gas in its primary energy will then grow to 9%. The Middle East will see the 2nd biggest increase, its share in world consumption growing from 10% in 2010 to 17% in 2035. Its share in world production will also grow from 15% to 19%. OECD countries, especially Europe, will accelerate the switch from coal to natural gas. The Eastern countries, with China leading the way, will remain heavy consumers of coal and while gas's share increases, in OECD Asia it is at the expense of oil rather than coal.

Natural gas releases 50% less carbon in the atmosphere than coal and close to zero sulphur. Its extraction is generally less hazardous and polluting than coal and it obviously does not present the same risks as nuclear energy. But it is still a net CO_2 emitter.

Reserves are currently estimated at 180 trillion m3, which would cover 60 years at current consumption rates. This number of 180 trillion m3 represents "conventional" gas reserves. Recently though, the development of "unconventional" gas, especially in the US, has been nothing less than a game-changer, with profound consequences on the way we see gas, its prices and its environmental impact.

"*The technological revolution in unconventional gas has been the single most important energy innovation so far this century,*" says Daniel Yergin, Information Handling Services: Cambridge Energy Research Associates (IHS CERA) Chairman and author of the Pulitzer-Prize winning book *The Prize*.

Shale gas – The Elephant in the Room

Shale gas is natural gas that is produced from reservoirs predominantly composed of shale with lesser amounts of other fine-grained rocks, rather than from more conventional sandstone or limestone reservoirs. The gas shales are often both the source rocks and the reservoir for the natural gas.

Drilling and production of gas shales in many cases is very similar to that of conventional natural gas reservoirs; however, due to a lack of permeability, gas shales almost always need to be broken, what is called "fracture stimulation" and often require higher well densities. According to the Canadian Association of Petroleum Producers a primary concern in producing shale gas is protecting fresh water aquifers. Water used in drilling or fracturing comes from lakes, rivers, local supply or existing oil, gas or water wells. Here lies the main issue with shale gas.

Besides requiring huge amounts of water, the high-pressure injection of water and sand mixed with chemicals necessary to fracture the shale (a process called hydraulic fracturing or fracking) cannot be contained and inevitably leaks into water aquifers. The industry replies that fracking takes place so far below the aquifers that there is no risk of contaminating water supplies. The evidence however, is not there. Even if this were found to be true, water contamination is not the only risk. Cuadrilla, which has

Case Study 4:

South Africa - Venda Communities say No! to CoAL Mining

"Minerals and metals are the heart of the Earth. They are there for a reason. If we remove the minerals and materials like coal or gold, it is like removing a person's heart. Our *Zwifho*, our sacred sites, they will die if minerals or metals are removed. Their life force will be drained. If we do this we will kill *Mupo*, our Mother Earth."

Dzomo la Mupo (Voice of the Earth), Custodians of the Network of Sacred Sites in Venda, South Africa.

Venda, South Africa. Photograph by Will Baxter

Venda in Limpopo Province is well known for its biodiversity and cultural heritage. To the Venda peoples the indigenous forests, rivers, mountain peaks and waterfalls are places of vital ecological, cultural and spiritual importance – revered as sacred sites. The network of sacred sites are protected by custodial clans. The elder women within these clans - the *Makhadzi* - are known as the "rainmakers" of South Africa, who practice cultural traditions of rainmaking to maintain the health and integrity of the local ecosystems.

However, Venda's cultural and ecological diversity are increasingly threatened by land grabbing, development projects, tourism and now mining. Coal of Africa (CoAL), an Australian mining company, has proposed the Makhado Coking Coal Project. If this goes ahead, the community faces severe ecological, social and economic damage to their ancestral homes. The biggest concern is water because this is an area where water is already scarce. CoAL has admitted that the project will exhaust the underground water in the Venda area by 2014, and this is without even considering the water needs of the local community, or the water consumption of the neighbouring Vele mine also owned by CoAL in the Limpopo province. A report 'Mine Not – Waste Not' by an international expert, commissioned by the communities, reveals that CoAL has failed to provide complete water studies for the project and has yet to be granted a water license. There is also a high risk of contaminated water from the mine seeping back into the water table and polluting ground water.

The Report also highlights how CoAL's Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) are incomplete. CoAL refused, despite it being illegal to do so, to give the interested and affected parties copies of their prospecting permit and their Environmental Management Programme for Makhado.

Civil society groups have mobilised in response, demanding recognition of the fact that no water license has yet been granted and asking global share-holders and potential investors to reconsider their investment in the CoAL Makhado project.

Dzomo la Mupo are calling for recognition of their sacred sites as 'No-Go Zones' for development and extractive industries. Having developed principles, local constitutions and community governance plans, the custodians are seeking legal recognition of their responsibility to protect their network of sacred sites according to their customary governance systems, under national and international laws.

For more information:

- *Mine Not – Waste Not: A preliminary critique of aspects of the CoAL (Coal Africa Ltd) Makhado Colliery Project Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP). http://www.gaiafoundation.org/sites/default/files/documents/MineNotWasteNot_december2011.pdf*
- *Open letter to South African Minister of Water and Environmental Affairs 15/11/2011 - http://www.minesandcommunities.org/article.php?a=11319&l=1*
- *Gaia Foundation - www.gaiafoundation.org/galleries/albums/makhadzis-defenders-sacred-sites*
- *Mupo Foundation - www.mupofoundation.org*

started working on a shale gas deposit in Lancashire in the UK, recently admitted that two minor earthquakes that happened off the Lancashire coast were the likely consequence of its fracking operations.[12]

A new study by Cornell University[13] is adding more fuel to the fire. In it, the authors claim that methane, the chief component of natural gas, is escaping into the atmosphere in far larger quantities than previously thought, with as much as 7.9% of it puffing out from shale gas wells, intentionally vented or flared, or seeping from loose pipe fittings along gas distribution lines. This would debunk the usual accepted notion that gas is much friendlier than coal on Greenhouse Gas. Mr. Howarth, a professor of ecology and environmental biology and the lead author of the study, said his analysis, which looked specifically at methane leakage rates in unconventional shale gas development, was among the first of its kind and that much more research was needed. Another study, from Proceedings of the National Academy of Sciences of the United States of America (PNAS),[14] reads as follows: "*Directional drilling and hydraulic-fracturing technologies are dramatically increasing natural-gas extraction. In aquifers overlying the Marcellus and Utica shale formations of Northeastern Pennsylvania and upstate New York, we document systematic evidence for methane contamination of drinking water associated with shale-gas extraction. We conclude that greater stewardship, data, and—possibly—regulation are needed to ensure the sustainable future of shale-gas extraction and to improve public confidence in its use*".

The debate is sure to be raging. The stakes indeed could not be higher. With shale gas, the US believes it has found the miracle cure: gas, the "cleanest" fossil fuel, available at home, in vast quantities, ensuring a safe and secure domestic energy supply for decades to come and generating thousands of jobs in the process. For energy companies and politicians alike, it is a dream come true. But the nagging issue of environmental pollution generated by fracking does not want to go away. A report by Democrats in the US Congress,[15] released in April 2011, said that between 2005 and 2009, a total of 780 million gallons of hydraulic-fracturing products had been used by 14 companies. More than 2,500 products containing chemicals and other components were used, including 29 known or possible human carcinogens, regulated under the Safe Drinking Water Act for their risks to human health or listed as air pollutants. "*In many instances, the oil and gas service companies were unable to identify these proprietary chemicals, suggesting that the companies are injecting fluids containing chemicals that they themselves cannot identify*", Democrats on the Energy and Commerce Committee said. But the stakes are not limited to the US alone. The initial success of the US industry has not gone unnoticed abroad and many countries are now keen to replicate that success at home. So far, France is the only country which has put a moratorium on all shale gas extraction.

It is hard to overstate the importance of shale gas and more generally, of unconventional gas, in the redefinition of energy policies going forward. The earthquake and tsunami in Japan, their impact on nuclear energy, and the unrest in the Middle East, reminding everyone how volatile the region is, recently combined to make an even more powerful case for domestic natural gas. The IEA last year estimated the reserves of unconventional gas at 385 trillion m3, covering 130 years of current consumption. It was then predicting that the share of unconventional gas in the total natural gas output would climb from 12% in 2008 to 19% in 2035. In light of the recent events, this seems understated and it will take a massive effort by civil society to try and control this development and to mitigate the consequences of fracking on the environment. The genie is clearly out of the bottle, and as we saw earlier with carbon capture, it is a genie hard to resist - the temptation to rely on quick-fixes, in a business-as-usual scenario that avoids questions about our wasteful way of life, globally, is just too strong.

Nuclear Energy

The tragedy at Fukushima has driven some countries away from nuclear energy but after a pause to reassess safety the planned expansion of nuclear energy worldwide is going ahead, led by Asian countries.

The most successful PR exercise in recent times has been the rebranding of nuclear energy into a "green" energy, on the basis that its record is better than fossil fuels on CO2 emissions. This is not to say that nuclear energy does not release CO2. Indeed it does, in the building of the reactors themselves and in the mining, transporting and processing of uranium. However, even eminent scientists and environmentalists like James Lovelock have endorsed it – considering that its inherent dangers and flaws were a better risk than runaway greenhouse gas emissions. The pollution generated by uranium mining, the health hazards of living near a nuclear plant, the impact on ecosystems of releasing vast amounts of hot water in nearby rivers or seas, the terrifying consequences of a major accident, the yet unsolved problem of radioactive waste disposal – all these fundamental issues have been relegated to the status of necessary evils in the crusade against CO2.

Even the Fukushima disaster in Japan last year does not seem to be fundamentally changing the future of nuclear energy. Granted, some industrialised nations have said they would gradually phase out nuclear power (Germany, Switzerland, Belgium), but the major nuclear powers (UK, USA, France, Russia) will not change direction. Meanwhile major developing nations, after pausing for a short while, are more than likely to resume the massive expansion of their nuclear capacity in the face of the relentless need for additional power (China, India).

12 Cuadrilla Resources (2011) *Findings of Report on Seismic Events Published*. Press Release: 2 November 2011. URL: http://www.cuadrillaresources.com/wp-content/uploads/2011/12/Cuadrilla-Resources-Press-Release-02-11-11.pdf

13 Howarth, R. et al. (2011) *Methane and the Greenhouse-gas Footprint of Natural Gas from Shale Formations*. URL: www.sustainablefuture.cornell.edu/news/attachments/Howarth-EtAl-2011.pdf

14 Osborn, S. et al. (2011) *Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing*. PNAS. URL: http://www.pnas.org/content/early/2011/05/02/1100682108.full.pdf+html

15 Democrat Committee on Energy and Commerce (2011) *Committee Democrats Release New Report Detailing Hydraulic Fracturing Products*. URL: http://democrats.energycommerce.house.gov/index.php?q=news/committee-democrats-release-new-report-detailing-hydraulic-fracturing-products

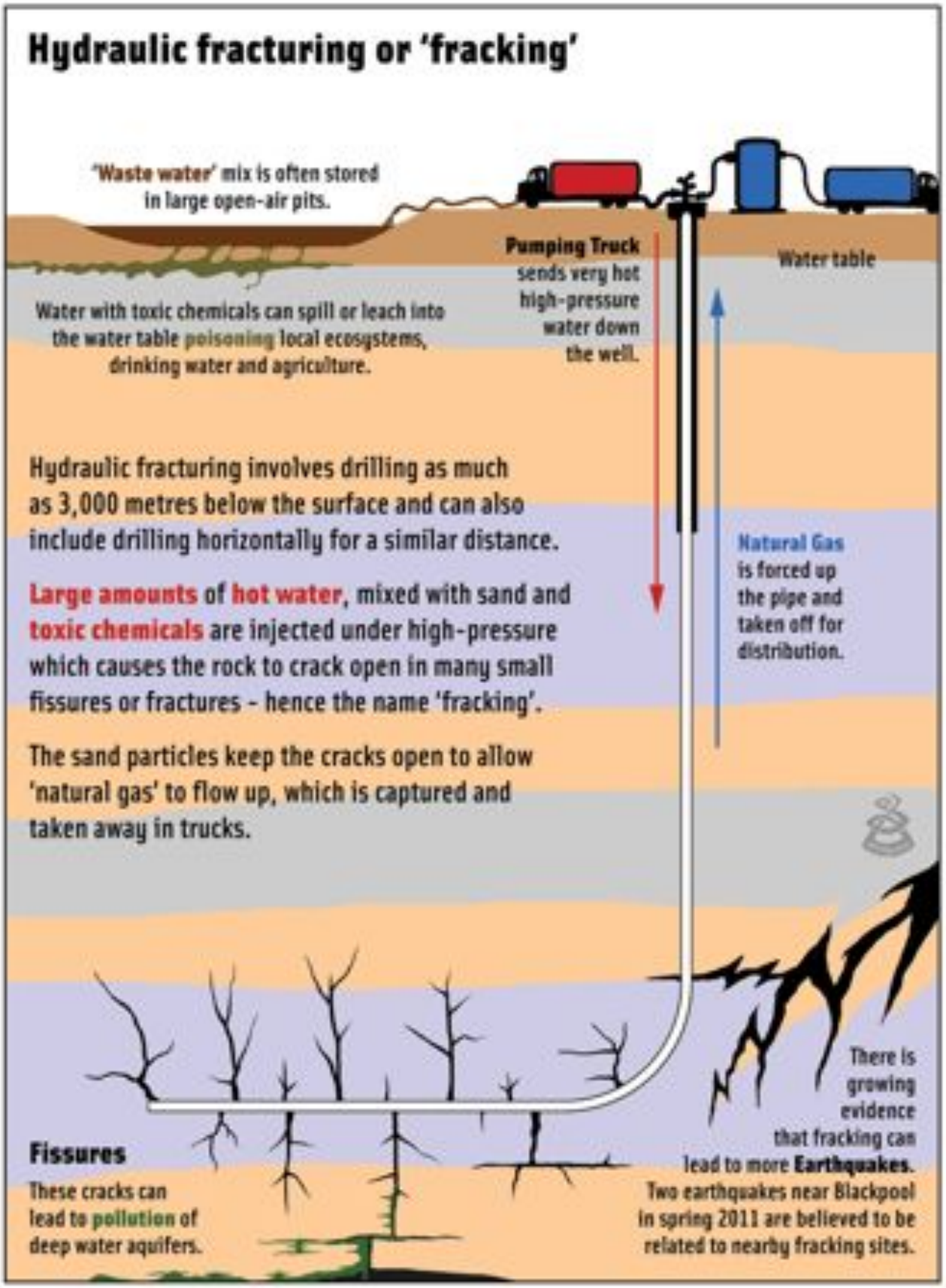

Hydraulic fracturing or 'fracking'
'Waste water' mix is often stored in large open-air pits.
Pumping Truck sends very hot high-pressure water down the well.
Water table
Water with toxic chemicals can spill or leach into the water table poisoning local ecosystems, drinking water and agriculture.
Hydraulic fracturing involves drilling as much as 3,000 metres below the surface and can also include drilling horizontally for a similar distance.
Large amounts of hot water, mixed with sand and toxic chemicals are injected under high-pressure which causes the rock to crack open in many small fissures or fractures - hence the name 'fracking'.
The sand particles keep the cracks open to allow 'natural gas' to flow up, which is captured and taken away in trucks.
Natural Gas is forced up the pipe and taken off for distribution.
Fissures
These cracks can lead to pollution of deep water aquifers.
There is growing evidence that fracking can lead to more Earthquakes. Two earthquakes near Blackpool in spring 2011 are believed to be related to nearby fracking sites.

fig.2

Case Study 5:

Fracking in Dimock, USA – Toxic Water turns to Fire

"We are 65 percent water by weight. Drinking water becomes our blood plasma, our cerebral spinal fluid, our sweat, and our tears. It is the steam of our exhaled breath on a cold winter's day. There is no other human right as fundamental as the right to clean water, which is the right to Life itself."

*Health experts in letter to U.S. Environmental Protection Agency. **

The health of ecosystems and communities in 31 states in USA is being threatened by hydraulic fracturing (fracking). The hidden impacts of fracking are now surfacing with increased incidences of contaminated water, earthquakes and destruction of ecosystems on an enormous scale.

The small town of Dimock, Pennsylvania has become a symbol across the USA of the impact of fracking. Dimock is situated above the Marcellus shale deposit and has been described as "ground zero" in the battle over whether fracking is safe.[1] In 2008, Cabot Oil and Gas approached residents to sign leases to allow the company to drill on their land.

The costs of drilling have been higher than was foreseen. Soon after fracking began, the drinking water became polluted and residents were shocked when their tap water caught fire. On 1 January 2009, the water well of one resident blew up due to high levels of methane that had escaped during the fracking process and leaked into the aquifer, and then into their well.[2] Many residents have experienced health problems due to high levels of methane and other metals in the water.[3] A resident in Dimock who has been unable to drink water from her tap for three years lamented – "We never imagined that we would not be able to drink our local water."[4]

Initially Cabot Oil and Gas provided 11 families in Dimock with bottled water daily until November 2011 when deliveries suddenly stopped. Residents have been left to seek alternative water sources alone.[5]

In January 2012, 20 health experts urged the Environmental Protection Agency to investigate water contamination and provide residents of Dimock with access to safe drinking water.

The Environmental Protection Agency has now intervened and will supply water for several families, as well as testing wells in the area. Data has revealed dangerous levels of arsenic and other chemicals in the water.[6]

There is currently a moratorium on drilling in the Dimock area, but the town continues to be plagued with the legacy of environmental destruction. Dimock is becoming one of many towns in the USA and globally to suffer from the rapid spread of fracking. This new extractive technology is being sold as a 'greener' and 'cleaner' form of energy. A momentum is growing to ban fracking across the world, as the dire consequences alert people to the fact that the short and long-term cost is too high. In Pittsburgh for example, the City Council passed this Ordinance in 2011:

"Toxic Trespass Resulting from Unconventional Natural Gas Drilling" makes it illegal to deposit toxic substances or potentially toxic substances within the body of any resident of Pittsburgh, or into any natural community or ecosystem…as the result of activities prohibited by…Ordinances of the City, or through negligent actions which result in a violation of any provision of this ordinance…[such actions are] declared a form of trespass, and [are] hereby prohibited."[7]

For more information:

- *Community Environmental Legal Defense Fund – http://www.celdf.org*
- *Press release: Gasland film - http://www.gaslandthemovie.com/whats-fracking/*
- *Frack off UK - http://frack-off.org.uk/*

* Cited in Zelman, J. (2012) 'Dimock, Pennsylvania Fracking Rollercoaster Continues As Health Experts Push EPA', The Huffington Post, 10 January 2012, http://www.huffingtonpost.com/2012/01/10/dimock-pennsylvania-fracking-epa_n_1197361.html (accessed on 7 February, 2012).

1 State Impact Pennsylvania (2012) 'Dimock, PA: "Ground Zero" In The Fight Over Fracking', Online: http://stateimpact.npr.org/pennsylvania/tag/dimock/page/2/ (accessed on 7 February, 2012).

2 Lustgarten, A. (2009) 'Officials in Three States Pin Water Woes on Gas Drilling', ProPublica, 26 April 2009, http://www.propublica.org/article/officials-in-three-states-pin-water-woes-on-gas-drilling-426 (accessed on 7 February, 2012).

3 Zelman, J. (2012) 'Dimock, Pennsylvania Fracking Rollercoaster Continues As Health Experts Push EPA', The Huffington Post, 10 January 2012, http://www.huffingtonpost.com/2012/01/10/dimock-pennsylvania-fracking-epa_n_1197361.html (accessed on 7 February, 2012).

4 Legere, L. (2009) 'Nearly a year after a water well explosion, Dimock Twp. residents thirst for gas-well fix', The Times-Tribune, 26 October 2009, http://thetimes-tribune.com/news/nearly-a-year-after-a-water-well-explosion-dimock-twp-residents-thirst-for-gas-well-fix-1.365743#ixzz1lo1OCRtl (accessed on 7 February, 2012).

5 Ibid.

6 Lustgarten, A. (2012) 'Years After Evidence of Fracking Contamination, EPA to Supply Drinking Water to Homes in Pa. Town', ProPublica, 20 January 2012, http://www.propublica.org/article/years-after-evidence-of-fracking-contamination-epa-to-supply-drinking-water (accessed on 7 February, 2012).

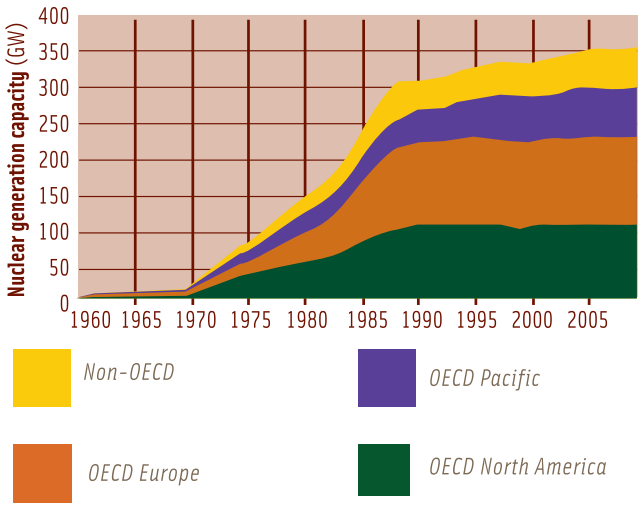
7 Community Environmental Legal Defense Fund (CELDF) (2011) Press Release: Pittsburgh Council Votes to Ban Upstream Poisoning of City Residents and the Environment Caused by Corporations Fracking for Shale Gas, December 20th, 2011 http://celdf.org/celdf-press-release-pittsburgh-council-votes-to-ban-upstream-poisoning-of-city-residents-and-the-environment-caused-by-corporations-fracking-for-shale-gas

Public opinion might disagree though. A November 2011 poll carried out by the BBC in 23 countries[16] came up with the following results: most (people) are significantly more opposed to nuclear power than they were in 2005, with just 22% agreeing that nuclear power is relatively safe and an important source of electricity, and we should build more nuclear power plants. 71% thought their country could almost entirely replace coal and nuclear energy within 20 years by becoming highly energy-efficient and focusing on generating energy from the sun and wind. Globally, 39% want to continue using existing reactors without building new ones, while 30% would like to shut everything down now. In Germany, where the government decided to phase out its nuclear programme, opposition to new reactors has grown from 73% in 2005 to 90% today. In France, which is 80% reliant on nuclear power, opposition rose from 66% to 83%. Surprisingly, in Japan, new reactor opposition showed a more modest rise, from 76% to 84%. Britons and Americans both supported building new reactors – those in favour rose from 33% to 37%; in the US the number was unchanged from 2005.

Status of Nuclear Energy Today

Nuclear energy enjoyed a rapid expansion in the 60s and 70s before slowing down dramatically in the 80s and 90s, after the Three Mile Island and especially the Chernobyl accidents. Given the lead-time to construct nuclear plants, in effect it meant that new reactors were built up until 1990. The next 15 years saw a long nuclear "winter" that lasted until the mid-2000s when the industry successfully managed to drape itself in environmental clothing. Coupled with the emergence of China, India and other energy-thirsty nations, it gave a new lease of life to nuclear energy.

6. WORLD NUCLEAR GENERATING CAPACITY, 1960 TO 2009



Graph shows the growth in global installed nuclear capacity. Nuclear capacity grew rapidly in the 1970s and 1980s, but much more slowly after 1990.

Source: IAEA PRIS in: IEA (2010) *Technology Roadmap: Nuclear Energy*.

In 2008, construction started on 10 new reactors, the first double-digit increase since 1985. At the end of 2010, 440 reactors were in operation in 29 countries, with an installed capacity of 375GW. The relative weight of nuclear energy in the electricity mix varies considerably between countries, with France by far the most reliant on nuclear power (a spot once occupied by Lithuania, which closed its last Soviet-era reactor in 2009. This reactor was similar to Chernobyl's and decommissioning it was a pre-requisite for Lithuania's admission to the EU. Plans are under way for a new reactor to be built by 2020, in cooperation with neighbouring Poland, Latvia and Estonia).

China currently possesses 13 reactors and India has 20. This is however about to change, with big plans to expand in the near future. As reported by the World Nuclear Association 61 reactors are today under construction in the world (including 27 in China, 10 in Russia, 5 in India), with an additional 158 on order or planned (50 in China, 14 in Russia, 18 in India) and 326 proposed (110 in China, 30 in Russia, 40 in India). All these additional reactors, if indeed they are built, would more than double the world's current nuclear capacity. The accident at Fukushima is of course having important consequences – in effect slowing down the expansion of nuclear energy - but without fundamentally altering it (Germany and Japan being exceptions).

A Green Energy?

Supporters of nuclear energy point to a number of reasons to justify their unflinching support: the inevitable need for the world to generate extra electricity, the rise in oil prices, energy security, the unproven record of large-scale renewables, the reliability of nuclear energy (compared to wind energy for instance), its intensity (one 7 gram uranium fuel pellet has an energy to electricity equivalent of 17,000 cubic feet of natural gas, 564 litres of oil or 1,780 pounds of coal), and its CO_2 record vs fossil fuels.

To justify the green credentials of nuclear energy, its proponents look at the emissions of CO_2 at nuclear plants – which indeed are close to zero: a nuclear plant's only outputs are heat and radioactive waste. However, this view is extremely limited – it does not take into account the full life cycle of the plant, and the mining, processing and transportation of the uranium. In 2008 a study, based on the analysis of one hundred life cycles of nuclear plants around the world, was carried out by the National University of Singapore and reported by the journal Nature.[17] It found that CO_2 was released at the following stages:

- *Upstream (uranium mining, processing and enrichment -38% of total emissions),*
- *Construction of the plant (12% of emissions - The Ecologist, in another study, found that each reactor emits 20 million tons of CO_2 in its construction),*
- *Operation of the plant (17%, largely because of backup generators using fossil fuels during downtime),*
- *Fuel processing and waste disposal (14%),*
- *Decommissioning (18%).*

16 Black, R. (2011) Nuclear Power 'Gets Little Public Support Worldwide'. *BBC News Science and Environment*. URL: http://www.bbc.co.uk/news/science-environment-15864806

17 Kleiner, K. (2008) 'Nuclear Energy: Assessing the Emissions' *Nature* (online edition). URL:www.nature.com/climate/2008/0810/full/climate.2008.99.html

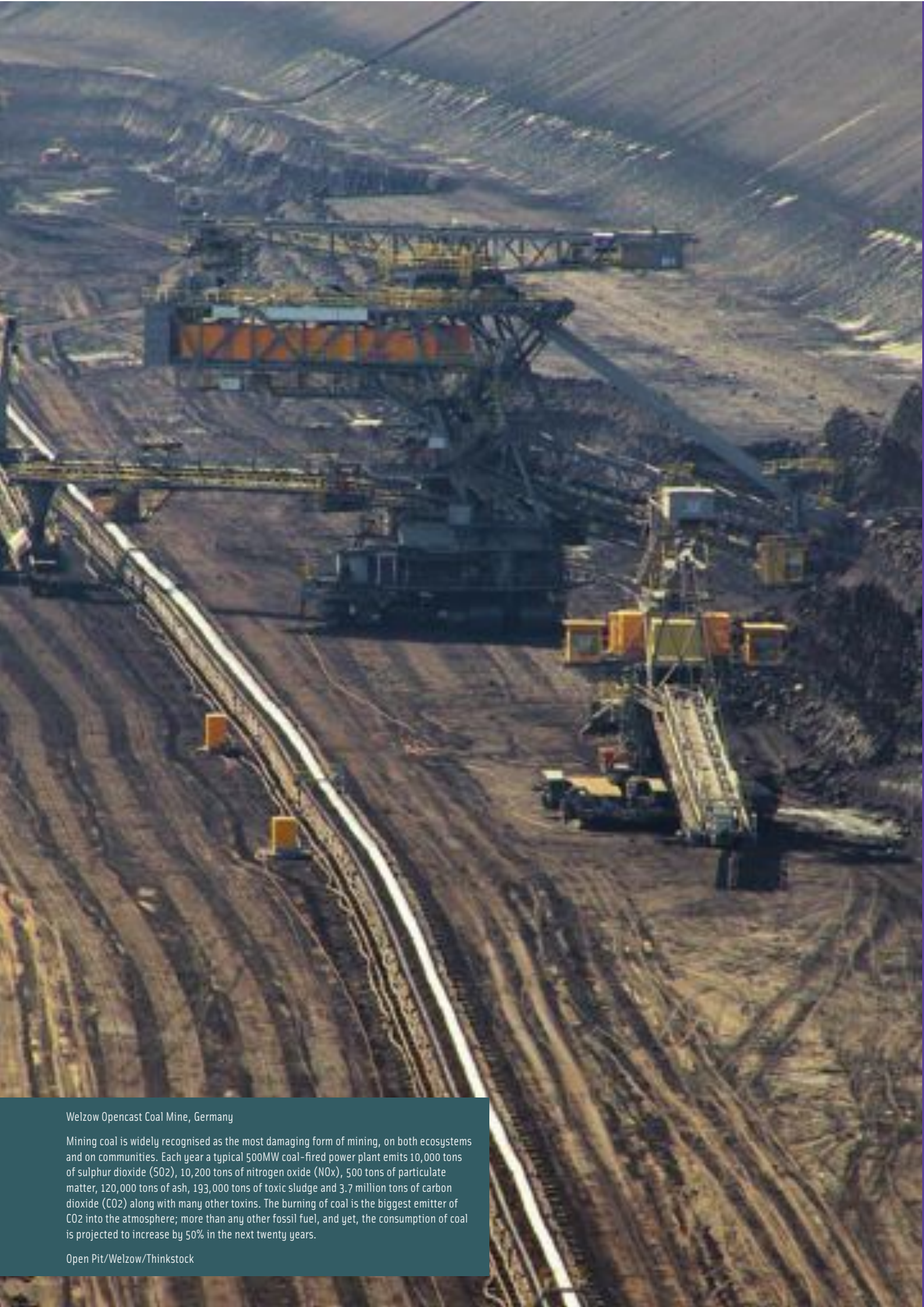
Additionally, a host of other environmentally damaging outputs beyond CO_2 are generated by nuclear energy:

- **Uranium mining.** *The tailings or waste left by the milling process consist of ground rock particles, water, and mill chemicals, and radioactive and otherwise hazardous contaminants, such as heavy metals (nickel, copper, arsenic, molybdenum, selenium and cadmium). In fact, up to 85% of the radiological elements contained in the original uranium ore end up in the tailings. Surface mines can generate up to 40 tonnes of waste rock for very tonne of uranium ore produced, while underground mines produce about one tonne of waste rock per tonne of ore.*[18]
- **Health and safety around the plants.** *Recent studies of millions of people living near 200 nuclear facilities show, beyond any doubt, an association between the incidence of childhood leukaemia and the presence of a nuclear facility, for up to 15 kilometres around the plants.*[19]
- **Accidents.** *For example, Three Mile Island, Chernobyl, Fukushima and countless minor ones never talked about. "No reactor that I know of can indefinitely take care of itself without external intervention" said James Acton, Associate, Nuclear Policy Program at the Carnegie Endowment for International Peace. "Fukushima was a beyond-design basis event. The earthquake and particularly the tsunami were much larger than the plant was designed to withstand. You can have the most modern, sophisticated, well-run reactor in the world but if it is hit by a beyond basis event, then you cannot guarantee the safety of the reactor".*[20] *And in a world subject to dramatic and unexpected changes in the climate, and high risks of terrorist attacks, the probability to be confronted in the future at one or more of nuclear plants to a "beyond-design" event has to be pretty high.*
- **Waste disposal, or lack of it.** *Disposing of radioactive waste is one of the major issues facing the nuclear industry today. And it is an issue that, although looked at for many years, remains unsolved in any satisfactory way.*
- **Nuclear weapons.** *Extraction of uranium underpinning the nuclear energy industry can be diverted to nuclear weapons. This is the main issue triggering the dispute between Iran and the international community today.*

18 Environmental Health Association of Nova Scotia (2008) *Nine Facts You Need to Know about Uranium Mining*. URL: http://www.environmentalhealth.ca/fall08ninefacts.html

19 Notebaert, E. (2011) A Few Good Reasons Why We Should Abandon Nuclear Energy for Good. *David Suzuki Foundation Blog*. URL:http://www.davidsuzuki.org/blogs/docs-talk/2011/01/a-few-good-reasons-why-we-should-abandon-nuclear-energy-for-good

20 Boselli, M. and De Clercq, G. (2011) *Reuters Special Report: The Nuclear Industry's Trillion Dollar Question*. URL: www.reuters.com/article/2011/04/18/us-nuclear-industry-idUSTRE73H0PR20110418



Welzow Opencast Coal Mine, Germany

Mining coal is widely recognised as the most damaging form of mining, on both ecosystems and on communities. Each year a typical 500MW coal-fired power plant emits 10,000 tons of sulphur dioxide (SO_2), 10,200 tons of nitrogen oxide (NO_x), 500 tons of particulate matter, 120,000 tons of ash, 193,000 tons of toxic sludge and 3.7 million tons of carbon dioxide (CO_2) along with many other toxins. The burning of coal is the biggest emitter of CO_2 into the atmosphere; more than any other fossil fuel, and yet, the consumption of coal is projected to increase by 50% in the next twenty years.

Open Pit/Welzow/Thinkstock

METALS AND MINERALS

In the last ten years, mining has witnessed a massive expansion of its scope and range. With the economic development of the East, the increase in worldwide population and the arrival of new green and communications technologies, the demand for metals and minerals has never been so high. The consequences on ecosystems, communities and climate change are just staggering. Everyone and everything on Earth is affected.

Impact of Mining

This chapter will essentially cover non-energy metals and minerals:

Metals

- *Base metals: copper, lead, zinc, aluminium*
- *Ferrous metals: iron, manganese, chromium, vanadium*
- *Precious metals: gold, silver, PGM (platinum, palladium, iridium...)*
- *Specialty metals: rare earths, lithium, indium, gallium, etc...*

Non-metal minerals

- *Industrial: limestone, dolomite*
- *Fertilizer: potash, phosphate rock*
- *Construction minerals: sand, gravel, stone, cement.*

Mining comes in very different forms and shapes. There are 25,000 industrial-minerals mines in the world, and 100,000 quarries producing aggregate (materials used in construction, including sand, gravel, crushed stone, slag and recycled concrete). China alone is said to have 140,000 mines of all kinds, a problem generating massive pollution, safety issues and smuggling on a large scale. Conscious of the problem, the Chinese government has embarked on a big drive to consolidate the industry, in particular on coal and rare earths, contributing to a significant loss of global supply and a subsequent increase of some imports (e.g. coal) and decrease of some exports (e.g. rare earths). 90% of the value of the world's mined coal and metals, roughly $2,300 billion, is realised by 2,000 mines only (roughly 1,000 coal mines, 1,000 metals mines). The total value of annual mined production is split as follows (2008 figures): coal/lignite $800 billion, metals and gems $800 billion, cement and aggregates $500 billion, industrial minerals $200 billion.

7. GLOBAL ANNUAL MINING OUTPUT OF MAIN PRODUCTS

Product	Quantity Mined in tonnes
Coal	7,229,000,000
Iron Ore	2,800,000,000
Bauxite	220,000,000
Copper	16,100,000
Zinc	12,400,000
Lead	4,500,000
Nickel	1,800,000
Rare Earths	130,000
Silver	23,800
Gold	2,700
PGMs (Platinum Group Metals)	400

Source: Figures from the World Coal Association, and USGS: *Mineral Commodity Summaries 2012.*

The table above gives the global annual output (in tonnes) of main products. Coal takes first place, far above the rest, while iron ore's output, which finds its way in steel production, is bigger than the combined output of all other metals put together. Bauxite, from which aluminium is produced, is the second most mined metallic ore in the world.

Problems Generated by Mining

Waste

A report from Friends of the Earth Europe said that in 2007, the total weight of all the materials extracted around the world (mining, fishing, harvesting and logging) amounted to 60 billion tons, equivalent to 25kg/day for each person on the planet.[21] To this figure must be added more than 40 billion tons of materials removed from the soil surface but not used in production processes themselves, such as "overburden" from mining activities. "Overburden" is the term used to describe the ecosystem - the rocks, vegetation, soil - that lies above a coal seam or ore body, also called" waste" or "spoil" in the industry.

According to the Mining Journal, 50 billion tons of earth is moved every year by mining activities, 21 billion tons of which is wasted.

8. WASTE (IN MILLION TONNES)

	ORE (Mt)	WASTE (Mt)	TOTAL(Mt)
Metals Mines	6,000	12,000	18,000
Aggregates*	15,000	0	15,000
Coal Mines	7,000	8,000	15,000
Industrial Minerals	1,000	1,000	2,000
TOTAL	**29,000**	**21,000**	**50,000**

* Aggregates are materials used in construction, including sand, gravel, crushed stone, slag and recycled concrete.

Energy & Water

Mining and processing (pyrometallurgy and hydrometallurgy) require lots of energy, with titanium, aluminium and nickel the

21 FOE Europe (2011) *Under Pressure: How Our Material Consumption Threatens the Planet's Water Resources*. URL: www.foeeurope.org/publications/2011/Under_Pressure_Nov11.pdf

most energy-hungry metals. According to Thomas Graedel *et al.* [22] *"There are important physical and chemical reasons for the high energy consumption associated with metal production, namely chemical stability, availability and the extraction process used".* Such an energy-intensive industry inevitably comes with massive CO2 release – it is estimated that mining is responsible for 20% of global CO2 emissions.

Water is likely to be one of the major limiting factors in the extraction of metals in the future. Mining demands a huge amount of water already, and water is becoming very scarce: according to the Water Resources Group,[23] global water requirements are expected to grow from 4,500 billion m3 today (or 4.5 thousand cubic kilometres) to 6,900 billion m3 in 2030. This would be a full 40% more than is available. The implications are obvious.

Agriculture is the heaviest consumer of fresh water (around 70% of total consumption) but mining activities are also heavily dependent upon access to water – creating problems both upstream (strong competition with local farmers for access to water) and downstream (heavy pollution during and after mining operations are carried out). According to the Carbon Disclosure Project,[24] *"Approximately 68% of chemical and mining companies (that have responded) have experienced water-related business impacts in the past five years, the highest percentage of any sector. Production losses due to water shortages, flooding, and energy supply disruptions are commonly reported".*

Nickel (hydrometallurgical route) has an embodied water consumption of 377 litres/kg of metal, titanium 100 litres/kg, nickel (pyro) and steel (from iron) almost 80 litres/kg, aluminium (from bauxite) and copper (hydro) close to 40 litres/kg. But these figures pale in comparison to gold, whose own water consumption is estimated at 225,000 litres/kg.[25]

Environmental Pollution

Besides a huge amount of waste, which creates management problems of its own (toxic tailings, polluted water etc.), a number of environmental issues are generated by mining and processing activities (based on Thomas Graedel *et al. ibid.*):

- *Destruction of ecosystems such as with open pit mining and mountain top removal (MTR)*
- *Acid drainage into the soil, rivers and aquifers, poisoning water and soil*
- *"Halo" of natural (dust) and anthropogenic (toxins) pollution affecting water, soil and air*
- *Contamination of ground or surface water and sediments*
- *Release of toxic substances during beneficiation (the process by which the chemical or physical properties of the ore are improved or cleaned e.g. cyanide for leaching or mercury for amalgamation)*
- *Air emissions (suspended particulate matter by open cast mining)*
- *Pollutant discharge from abandoned mines*
- *Deforestation, destruction of biodiversity and extinction of species*
- *Wind and water erosion as well as sedimentation*
- *Specific pollution, e.g. "red mud" (caustic waste) generated during the conversion of bauxite into dehydrated alumina*
- *Loss of topsoil through mining and afterwards through erosion of the site*

Numerous studies and reports have documented the impact of mining activities on local communities. As reported by the *Financial Times*,[26] one such study, carried out in July 2011 by the peer-reviewed *Journal of Community Health*, posited that among the 1.2m people living in central Appalachian communities affected by Mountain Top Removal (MTR), there were an additional 60,000 cases of cancer directly related to the practice.

The Toxic Releases Inventory (TRI), published by the US EPA (Environmental Protection Agency) contends that 3.93 billion pounds of toxic chemicals were released into the US environment in 2010, a 16% increase from 2009, and that the metal mining sector was responsible for 41% of this total.[27]

Present and Future Challenges

Deterioration of Ore

An overall tendency in the degradation of the ore (i.e. the amount of minerals that can be recovered from rock) has been observed throughout the 20th century. For example, copper ore mined in the early 1900s contained about 3% copper. It is today typically 0.3%. The immediate consequence is increased extraction costs, the necessity to remove more soil to extract the same volume of metal, the need to increase the amount of water and energy used, and the generation of more waste in the process. In the case of copper, 1,000kg of copper now generates 300,000kg of waste. In the case of gold, the amount of ore is one-half to one million times the net gold content.[28]

Resource Depletion

Just as with oil, this is a contentious issue. The best figures on actual reserves per metal can be found on the United States Geological Survey (USGS) website.[29] The definition of reserves itself is subject

22 Thomas E. Graedel *et al.* (2010) (eds.), *Linkages of Sustainability*. MIT Press. p.132.

23 The Water Resources Group (2009) *Charting Our Water Future Economic Frameworks to Inform Decision-Making*. URL: http://www.2030waterresourcesgroup.com/water_full/Charting_Our_Water_Future_Final.pdf

24 Carbon Disclosure Project (2011) *CDP Water Disclosure Global Report 2011 Raising Corporate Awareness of Global Water Issues*. URL: https://www.cdproject.net/CDPResults/CDP-Water-Disclosure-Global-Report-2011.pdf

25 Thomas Graedel *et al. ibid*. p.137

26 Kennard, M. and Makan, A. (2011) Mining Groups Have a Mountain to Climb. *Financial Times*. November 8, 2011 URL: http://www.ft.com/cms/s/0/b045f0dc-0932-11e1-8e86-00144feabdc0.html#axzz1lgg1tUiM

27 Kosich. D. (2011) 'EPA Says Metals Mining Still Largest U.S. Toxic Releases Generator'. *Mineweb*. 6 January, 2012. URL: http://www.mineweb.com/mineweb/view/mineweb/en/page68?oid=142618&sn=Detail&pid=68

28 Thomas Graedel *et al., ibid*. p.101

29 See: www.usgs.gov

9.REPORTED RESERVES

	Gold	Platinum	Copper	Zinc	Nickel	Iron Ore	Metallurgical Coal	Thermal Coal	Bauxite	Potash
	(Million oz)						(Million Tons)			
No. of Companies	15	5	19	7	5	7	12	12	3	2
2009 reserves	582	211	271	40	19	14939	11449	67822	1177	746
(Depletion)	(34)	(4)	(7)	(3)	(1)	(716)	(226)	(1273)	(40)	(13)
Other net addition/ (reduction)	71	3	36	3	-	1278	336	831	(31)	25
2010 reserves	619	210	300	40	18	15501	11559	67380	1106	758
Change (%)	6%	(1%)	11%	0%	(4%)	4%	1%	(1%)	(6%)	2%
Remaining life (years)	18	51	41	12	21	22	51	53	27	57

Source: PwC (2011) *Mine 2011. The Game Has Changed: Review of Global Trends in the Mining Industry.*

to countless interpretations. The table above has been compiled by PricewaterhouseCoopers (PwC) in its 2011 "The game has changed" report.[30] It shows the total reserves reported by the Top 40 mining companies by market value or capitalisation.

As can be seen, the main metals have a remaining lifespan of between 12 and 50-odd years. However, there is no doubt that new technological developments will allow access to new areas in the future, deeper in the ground, and with likely increased consequences for ecosystems and communities – as can be seen with oil and gas. Recycling policies will also largely determine how much reserves are available. One can argue that the huge amounts of metals contained in discarded electronic items constitute reserves in themselves (the so-called "urban mining"). Contrary to fossil fuels, metals are never consumed, they are merely dissipated and they have an endless recyclability. According to Graedel,[31] 43% of the copper that has been mined in North America since 1900 remains in use, whereas 18% was lost during extraction (tailings and production wastes) and another 34% was lost to postconsumer waste (landfills). With improved mining, better product designs and efficient recycling, these figures could no doubt be vastly improved.

New Frontiers

With demand relentlessly increasing and with most easy catches already made, mining companies are now venturing into new territory to satisfy demand. Offshore mining is now firmly on the agenda (with a first development in Papua New Guinea), while climate change will open the Arctic region to further extraction. Greenland is attracting particular attention, with a number of deposits already identified, including the highly topical extraction of rare earths.

Technology Minerals

The development of technology and of green energy is having profound consequences on the fate of once obscure metals, now occupying a strategic position despite low volumes of extraction (compared to base metals). What are technology minerals? *Kaiser Bottom Fish* editor John Kaiser defines them as "*...metals that are a minor input for an end product, in terms of the total value of the end product relative to the cost of that input and yet that input is critical to the overall functionality of the end product. For example, steel pipes are not made of molybdenum, but molybdenum, which makes up 0.5% of the alloy, gives it corrosion resistance and strength. That makes molybdenum critical to gas pipelines.*"[32] They are sometimes dubbed "strategic" (for their military applications), or "critical" (for their importance to the economy).

A feature of many of these metals is that they are rarely mined for themselves – they are the by-product of the extraction of other metals like zinc or nickel. Tellurium for instance - a once obscure mineral - is now an essential component in new solar panel technology. But tellurium, a refinery by-product of certain copper concentrates, is not mined *per se*. The USGS estimates annual tellurium production at about 300,000 lbs, which at the current price of $200/lb. makes the tellurium market worth about $60 million per year, very small indeed compared to the $100 billion-plus value of annual copper production. No company is actually going to increase copper production just to meet tellurium demand. Indium, typically recovered by zinc refineries, is another example of an obscure metal suddenly desirable. Demand surged during the last decade when indium was found to be useful in display panels. However, it is a function of global zinc demand, not of indium demand and price.[33] With such complex and unreliable supply chains, indium recycling should be very high on the agenda. And yet Umicore, the world's largest precious metals recycling company, estimates that recycling rates for indium are no more than 1%. Without a doubt, the management of these specialty metals will be a major challenge in the years ahead for governments and countries alike.

30 PwC (2011) Mine 2011. *The Game Has Changed: Review of Global Trends in the Mining Industry*. URL: http://www.pwc.com/kz/en/about-us/Events/Mine_2011_eng.pdf

31 Thomas Graedel *et al., ibid*. p.116

32 The Gold Report (2011) *Critical Metals Myths, Markets and Geopolitics*. URL: http://www.theaureport.com/pub/na/9778

33 Roche, K and Long, J. (2011) 'John Kaiser: Alternative Energy Fuels a Mining Bloom'. *The Energy Report*. 5 December, 2011. URL: http://www.theenergyreport.com/pub/na/9557

Case Study 6:

The high price of Gold - Death and Destruction in Amazon Mineral Rush

"I'm worried – my people are suffering, there could now be as many as 2,000 illegal miners operating inside our Yanomami reserve. The miners are hiring planes to come into our territory. Their entry is constant. It is dangerous to go where they are. They are all armed. If we go near them they will kill us. We are getting information that the invaders are getting close to our lands. The Yanomami are asking for support."

*Dário Vitório Kopenawa**

Davi Yanomami. Photograph by Sue Cunningham

The Yanomami people have been living in a remote part of the Amazon Rainforest in northern Brazil and southern Venezuela for tens of thousands of years. Their 17.8 million hectares is one of the largest indigenous ancestral territories in the world, which they have protected for millennia. Their traditions are highly adapted to one of the planet's most complex ecosystems, which plays a vital role in maintaining the climatic stability of the Earth.

The Yanomami have been battling the detrimental impact of illegal gold mining on their land and livelihoods for decades. Their rivers and forests are being contaminated by mercury used to extract the gold. Cattle ranchers are entering through the roads carved out by the miners in the eastern part of the territory, clear-cutting forest for them to sell and settle. The miners have been transmitting fatal diseases to the community, which did not previously exist in the area, such as malaria. They are now suffering from poor health both from the miners and from their contaminated territory.

The invasion by the illegal miners into the Amazon fluctuates according to the gold price. It was reported in the Guardian in September 2011 that across the Amazon, the all-time record gold prices, which are the result of investors seeking a safe haven from the US and European economic slump, are reportedly adding fuel to a chaotic jungle gold rush. This has brought violence, disease and conflict to the mineral-rich rainforests of Brazil, Guyana, Peru, Bolivia, Colombia and Venezuela.

Nearly two decades after two thousand Yanomami people lost their lives during the last big gold rush, indigenous leaders in Brazil's Roraima state fear history may be repeating itself in their territory.

More and more impoverished miners are pouring into the Amazon in search of gold, leaving a trail of environmental and human destruction. Meanwhile, a recent study by academics from Duke University in North Carolina found that between 2003 and 2009 mining-related deforestation rose six-fold in Peru's Madre de Dios region. This area is home to perhaps the biggest single gold rush in South America.[34]

Currently a bill is being debated in the Brazilian congress which, if approved, would allow large-scale mining in indigenous territories. This would be a disaster for the precious rainforest and its indigenous peoples and the global climate, which this unique bio-cultural complex has been mediating for thousands of years.[35]

* Dário Vitório Kopenawa Yanomami,cited in Phillips, T. (2011) 'The high price of gold: death and destruction in Amazon mineral rush'. the Guardian. Monday 26 September, 2011, http://www.guardian.co.uk/environment/2011/sep/26/amazon-gold-rush-prices-soar.
Dário Vitório Kopenawa Yanomami, is the health co-ordinator for the tribe's Hutukara association and the eldest son of Davi Kopenawa Yanomami, a leader known throughout the world for his defence of the rights of the Yanomami people. See here for more info: http://hutukara.org/dário-vitório-kopenawa-yanomami/

34 Ibid.

35 Survival International (2012) The Yanomami. http://www.survivalinternational.org/tribes/yanomami#main

Supercycle?

Several reasons have contributed to the rapid rise in metal prices since 2002: raw material shortages, infrastructure constraints, financial speculation, a weak dollar, weather patterns, technological innovations and, increasingly, resource nationalism. But more than any other factor, the weight of China in international commodities, on the back of 8 to 10% annual growth rates, is the prime reason.

10. CHINA'S SHARE OF WORLD COMMODITY CONSUMPTION

Commodity	China % of World
Cement	53.2%
Iron Ore	47.7%
Coal	46.9%
Pigs	46.4%
Steel	45.4%
Lead	44.6%
Zinc	41.3%
Aluminum	40.6%
Copper	38.9%
Eggs	37.2%
Nickel	36.3%
Rice	28.1%
Soybeans	24.6%
Wheat	16.6%
Chickens	15.6%
PPP GDP	13.6%
Oil	10.3%
Cattle	9.5%
GDP	9.4%

Source: Barclays Capital (2010), Credit Suisse (2010), Goldman Sachs, United States Geological Survey (2009), *BP Statistical Review of World Energy (2009)*, Food and Agriculture Organisation of the United Nations (2008) IMF (2010).

China accounts for 40% of worldwide metal consumption, but it must of course be said that China re-exports a lot of these commodities to the rest of the world in the form of finished products. The question now is whether we are indeed entering a new period marking the "End of Cheap", or whether we are caught in the boom side of a super cycle which started in 2002 (notwithstanding the temporary blip of the 2008 financial crisis) and which will inevitably end up in a big bust, much as the previous ones did.

As seen above, much of the extra demand has come from China's rapid growth. At this stage though, one point must be addressed. Theoretically, when countries develop, their metals consumption follows a certain pattern. The intensity use (amount of metals needed per unit of GDP) rapidly increases then peaks before decreasing. This has been the case in Western nations and Japan. Building the infrastructure is very demanding in raw materials but, once it is built, the use of materials decreases while GDP rises, technology becomes more efficient and tertiary activities take over. Metals also peak at different times in the cycle. For Dr Wang Anjian, director of the Global Mineral Resources Strategy at the Chinese Academy of Geological Sciences, iron ore peaks first, then copper followed by aluminium and energy.[36] Dr Wang thinks that metal's intensity use will peak in China by 2025 but that the intensity use of steel (iron ore) might already have peaked in 2006. Which is not to say that steel consumption decreases: in absolute terms it keeps increasing, a lot, it's just that the economy is more efficient at growing with relatively less steel being used.

Of course, one might argue that Western nations have decreased their intensity use of metals by delocalising secondary activities, the main consumers of raw materials. Delocalising is akin to exporting the consumption of metals elsewhere. The real metals consumption of a country cannot be measured by its use of raw materials alone; it must be measured after exports and imports of finished products are included too.

Emphasising the point, the UNEP shows that material extraction embodied in global trade accounted for 20% of total worldwide material extraction in the year 2000. A debate, incidentally, that is very relevant to CO2 emissions too: according to the UNEP, a recent study indicated that CO2 emissions embodied in internationally traded products accounted for 27% of total energy-related CO2 emissions in 2005.[37] And for 20 big economies in the world, emissions of CO2 embodied in imports or exports can be 20 to 40% of their domestic emissions.[38] The consumption of consumer items does not decrease with revenue, quite the contrary, and these items must be produced somewhere. Once mature, will China delocate too? And if so, where? To have a complete picture we need to look at planet Earth from a global level, where it is obvious that, despite gains in use efficiency, more metals are being used and consumed year after year; whether the production takes place in Europe, China or Vietnam.

To go back to our point, if (or perhaps when) China's economy crashes down, or even softens, as is the case now, aren't we likely to see a big drop in the demand, and therefore the price, of commodities? We can already see today that when China sneezes, tightening money supply to rein in inflation for instance, the whole world shivers. On the other side of the equation, won't the record exploration budgets of the last few years bring about a big increase in production that will tip the balance and lead to oversupply? Nickel could be a case in point here, with new production coming on stream this year putting a bearish spin on the market. Copper too, and iron ore even more, have recently given back some of the price gains of the last years on the back of slower Chinese growth. This is how the cycle theory goes anyway, and certainly the history of the last few months shows that volatility is there to stay.

36 Mining Journal (2011) *Red Alert*. 17 June 2011. URL: http://www.mining-journal.com/comment/red-signal

37 UNEP (2011) *Ibid*.

38 UNEP (2011) *Assessing the Environmental Impacts of Consumption and Production: Priority Products and Materials*. URL: www.unep.org/resourcepanel/Portals/24102/PDFs/PriorityProductsAndMaterials_Summary_EN.pdf

But if we place ourselves in a longer term perspective, away from the short term economic cycles, it looks increasingly likely that we have reached a tipping point on commodities, and on metals in particular. This is from the double impact of population increase and economic development, bringing overgrown consumption in its wake, and increasingly rarer supply. Peak metals we might call it: A point in time when demand, on average, runs ahead of supply, and does so, crucially, at a time when supply sources are more expensive to develop, thereby putting a floor under prices. In China for instance, the cost of digging up iron ore is in excess of $120/ton while it was no more than $50/ton a decade ago. A time, therefore, when prices never stray too far down even in a context of low demand, and when they sharply increase in periods of tension. Earth is a finite planet and cannot endlessly provide for cheap runaway consumption.

Of course metals come in very different forms and are used in myriad ways so the situation is not uniformly spread throughout the periodic table of elements. A recent example of a big drop in price can be found with polysilicon, used in the production of solar cells and microchips. Bloomberg records show that polysilicon has plunged 93 percent to $33 a kilogram from $475 three years ago as the top five producers more than doubled output. The industry this year will produce 28% more of the raw material than will be consumed, up from 20% last year, and prices are now approaching cost of production. However, with companies and countries increasingly aggressive in their drive to find rarer, riskier and poorer deposits, and consequently more expensive ones, one has to assume that a radical shift in the balance of raw materials has occurred at the turn of the 21st century, the first consequence of which is a rise in prices. Very similar to oil, really, and a pattern increasingly obvious in agriculture, where productivity losses, soil exhaustion and more frequent extreme weather events are structurally constraining supply at a time of rising demand. A second consequence could be a critical shortage of some metals or minerals, unavailable at any price.

It is a time of reckoning, and it should entail very different behavioural patterns. But it does not. Instead, it just increases the pressure to find new deposits wherever possible, including in the most pristine and biodiverse regions of the world. Even the last protected areas of the world - National Parks, UNESCO Heritage sites - are under threat. The International Union for Conservation of Nature (IUCN), the advisory body to UNESCO on natural sites, recently raised concern over the rapidly increasing number of World Heritage Sites under threat from planned mining and oil and gas projects.[39] One in four iconic natural areas in Africa is negatively affected. "*The mining, oil and gas industries, as well as governments who license mineral extraction, should follow the example of business leaders who have already committed not to undertake mining and oil/gas projects within World Heritage sites*," says Tim Badman, Director of IUCN's World Heritage Programme. "*These exceptional places, which cover less than 1% of the Earth's surface, have been included on the World Heritage List because they are of outstanding value to all of humanity. It's the duty of every one of us to cooperate in their protection and conservation. That duty includes the extractive industry*".

IUCN's position, outlined in a new *World Heritage Advice Note*, is that mineral and oil/gas exploration and exploitation should not be permitted within natural World Heritage Sites. Mining and oil/gas projects that are located outside World Heritage Sites should not, under any circumstances, have negative impacts on these exceptional places. Moreover, boundary changes to these sites should not be used as an easy way to facilitate mining activities. African natural World Heritage sites threatened by commercial mining and oil/gas projects account for an astonishing 24% of the 37 African natural and mixed World Heritage sites, an increase from 16% in 2009.[40]

Trends: Going Forward

Demand

The axis has shifted. The so-called emerging countries are now driving the world's economic growth and will continue to do so for the foreseeable future. This is all the more evident when looking at the deep financial trouble some EU countries and the US find themselves in, with burgeoning debt and budget deficits, a lot of them financed by China. Even the role and position of the dollar is in doubt. We have already talked about China in this report but other Asian and Middle East countries are also on the path of rapid growth. This economic development requires a lot of base and ferrous metals. In India, metals demand may double in 5 years. The government is proposing to spend $1 trillion by 2017 to upgrade the nation's transport and power infrastructure. The growth in demand for base metals is likely to reach double digit figures this year – to be compared with average 1972-2009 growth rates of 6% for aluminium and copper, and 4.3% for zinc (in effect – the consumption of aluminium in 2009 was 8 times of what it was in 1972). According to Barclays Capital, the growth could reach 80% by 2015. Commodity demand in India has reached a "tipping point", and the nation may surpass the US as the second-largest consumer of copper, aluminium and zinc in the early 2020's, Barclays said.[41]

Base metals are conspicuous. They are the building blocks of our industrial world. However, a number of other metals and minerals, much less visible, are increasingly stealing the limelight. The so-called technology minerals are being used in many new technological innovations and they are undoubtedly going to play a bigger and wider role in the years to come. These minerals increasingly shape the actions of governments and companies alike – because of their importance to the world's "new" economy and because of their role in "green" technology. This latter role is very far from being recognised. Clearly here is a battleground for the future.

39 IUCN (2011) Mining Threats on the Rise in World Heritage Sites. *IUCN Online*. 27 June 2011 www.iucn.org/about/union/commissions/wcpa/?7742/Mining-threats-on-the-rise-in-World-Heritage-sites

40 Mines and Communities (2011) 'World Heritage Sites Threatened by Mining, Says IUCN'. 4 July, 2011. Online URL: http://www.minesandcommunities.org//article.php?a=11019

41 The Mining Journal (2011) Metals demand in India may double. 16 February 2011. URL: http://www.mining-journal.com/production-and-markets/metals-demand-in-india-may-double

11.TECHNOLOGY MINERALS AND THEIR DRIVING EMERGING APPLICATIONS

Raw material	Emerging Technologies (selected)
Gallium	Thin layer photovoltaics, IC, WLED
Neodymium	Permanent magnets, Laser technology
Indium	Displays, thin layer photovoltaics
Germanium	Fibre optic cable, IR optical technologies
Platinum	Fuel cells, catalysts
Tantalum	Micro capacitors, medical technology
Silver	RFID, lead-free soft solder
Cobalt	Lithium-ion batteries, synthetic fuels
Palladium	Catalysts, seawater desalination
Titanium	Seawater desalination, implants
Copper	Efficient electric motors, RFID
Niobium	Micro capacitors, ferroalloys
Antimony	ATO, micro capacitors
Chromium	Seawater desalination, marine technologies

Source: EC (2010) Critical Raw Materials for the EU: *Report of the Ad-hoc Working Group on Defining Critical Raw Materials.*

Supply

The EU, the US, China and Japan have become increasingly anxious to secure the supply of these technology metals and minerals. In 2010 the EU released a study which identified 14 "critical" minerals, labelled thus because of their importance to the European economy and because of the supply risks attached:[42] rare earths, Platinum Group Metals (PGM), antimony, germanium, magnesium, gallium, indium, beryllium, fluorspar, cobalt, tantalum, graphite, tungsten and niobium.

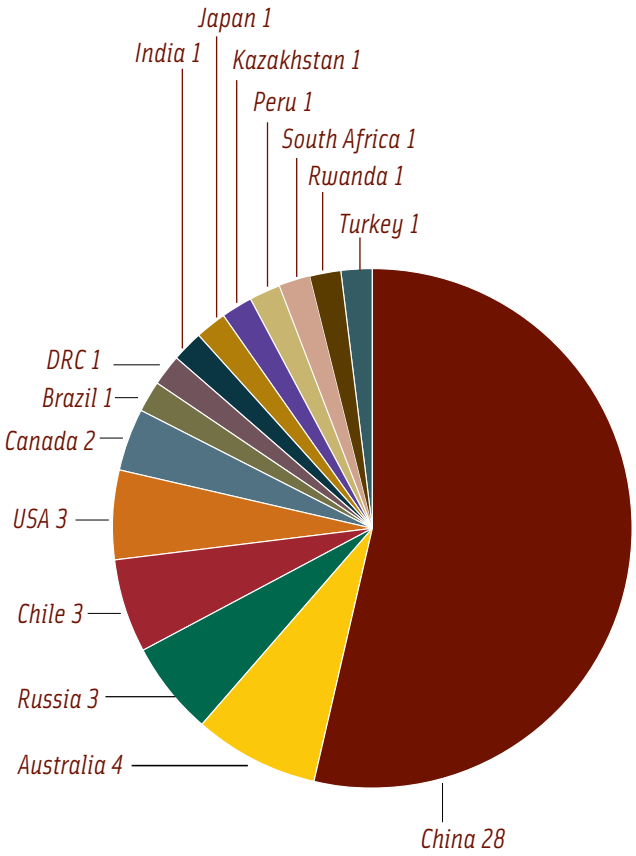
The British Geological Survey released its own report in September 2011[43] assessing 52 different metals and the risks to the supply of these elements "*...if we want to maintain our economy and lifestyle*". Antimony, PGM, rare earths, tungsten and niobium are classified among the most at risk. China is the leading producer in 28 of the 52 elements and groups of elements analysed in the report, but other countries also occupy major positions in some metals: Brazil for instance produces 92% of niobium, South Africa 75% of platinum and 37% of palladium, Russia 44% of palladium, the DRC 51% of cobalt and the USA 83% of Beryllium.[44]

42 European Commission (2011) *Enterprise and Industry. Raw Materials Defining 'Critical' Raw Materials*. URL: http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm

43 British Geological Society (2011) *Risk List 2011*. URL: http://www.bgs.ac.uk/mineralsuk/statistics/riskList.html

44 USGS 2010 figures. See: http://minerals.usgs.gov/minerals/pubs/mcs/2011/mcs2011.pdf

12. WHERE IN THE WORLD DO THE ELEMENTS WE USE COME FROM?

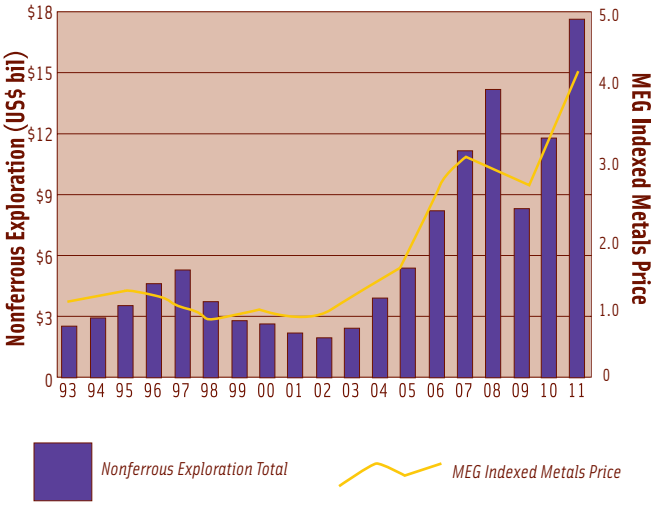


The pie chart shows the number of times a country is the leading global producer of an element. China is the leading producer in 28 of the 52 elements analysed in the report.
Source: BGS (2011) World Mineral Statistics

Since 2002 we have been witnessing a dramatic increase in exploration budgets, mirroring the evolution of demand. The result was a 45% increase in estimated worldwide nonferrous metals exploration spending in 2010 compared with 2009, and another 50% hike from 2010 to 2011 – exploration budgets are estimated to reach $18.2 billion in 2011, the highest figure ever, and six times the 1994 figure. The Metals Economics Group (MEG)[45] states: "*Most countries are seeing increased exploration investment in 2011, and explorers are demonstrating a higher tolerance for risk despite additional concerns and uncertainty about security, policy, and tenure in many countries. Of the 120 countries for which we documented exploration spending by the industry, those commonly perceived to be high-risk account for 23% of the 2011 aggregate exploration total, up from less than 16% in 2010. The potential reward often increases the industry's appetite for risk during periods of increased exploration spending, but exploration in high-risk countries, particularly early-stage work, is usually the first to be cut when risk levels or uncertainty increases*".

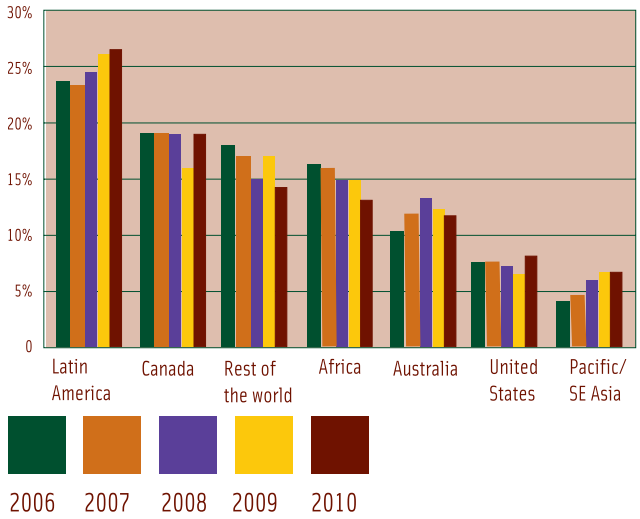
45 MEG (2001) Exploration Budgets up 50% - Surging to New All-time High. Press Release, November 23, 2011 URL: http://www.metalseconomics.com/sites/default/files/uploads/PDFs/corporate_exploration_strategies_2011.pdf

13. ESTIMATED WORLDWIDE EXPLORATION BUDGETS 1993-2011



Regionally, Latin America (led by Mexico, Peru, Chile, Brazil, and Argentina) was the top exploration destination (2010 figures) –a position it has held for the better part of two decades– while Canada was the top country overall. The provinces of Ontario, Quebec, Saskatchewan, and British Columbia attracted about two-thirds of total Canadian allocations. Planned expenditures for gold exploration in Canada increased dramatically to capture 54% of total spending. Africa (13%) is attracting marginally more spending than Australia (12%). Planned spending in Africa was heavily weighted towards four countries: Democratic Republic of Congo, South Africa, Zambia, and Burkina Faso, which together accounted for almost half the region's total.

14.EXPLORATION BUDGETS BY REGION, 2006 – 2010

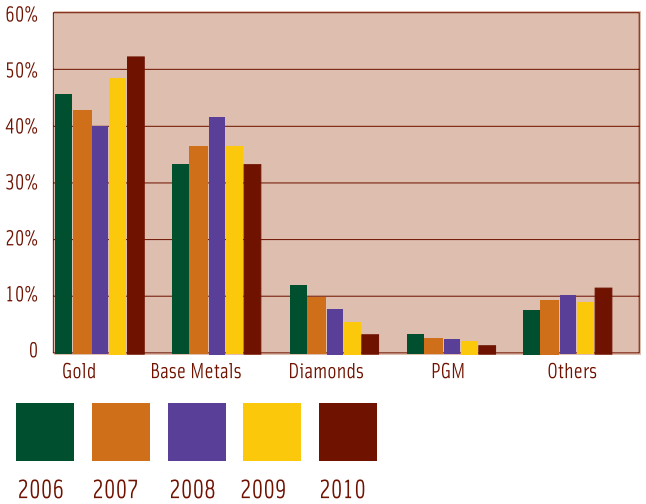


Values expressed as a percentage of exploration totals. **Source:** MEG (2011) World Exploration Trends 2011: *A Special Report from Metals Economics Group for the PDAC International Convention.*

Although exploration takes place all over the world, it is heavily geared towards a small number of countries. The top 10 countries represent 69% of all budgets.

Commodity-wise, gold is the leading target, attracting more than half the global exploration budget total, with copper a distant second. Ten countries– Canada, Australia, United States, Mexico, Russia, China, Peru, Colombia, Brazil, and Chile– accounted for two-thirds of the 2010 gold exploration budget total. Silver accounted for more than a third of the 'other targets' total; however, most silver exploration occurs in conjunction with the search for gold or base metals polymetallic deposits. Potash and phosphates – by far the most popular targets amongst the remaining 'other targets' – attracted more than 20% of the group's total. As demand for lithium and rare earth elements continued to increase in 2010, exploration budgets for these commodities jumped to almost four times the amount spent in 2009. Nevertheless, they remain a relatively small part of the industry's overall exploration effort, accounting for about 13% of the 2010 'other targets' total.

15.EXPLORATION BUDGETS BY TARGET, 2006 – 2010



Values expressed as a percentage of exploration totals. **Source:** MEG (2011) World Exploration Trends 2011: *A Special Report from Metals Economics Group for the PDAC International Convention.*

Governments in Action

Countries have always put in place policies to secure the supply of critical commodities, oil being the most obvious example. However, the new crucial technological applications of specialty metals and minerals are pushing countries to have a more aggressive attitude to secure their supply:

The EU has come up with a report entitled *Critical Raw Materials for the EU* which advises what steps to take to secure supply of these materials. In 2008, the EU developed the Raw Materials Initiative, recommending that the EU pursue raw materials diplomacy with a view to securing access to raw materials.[46] It

46 European Commission (2008) *The Raw Materials Initiative – Meeting Our Critical Needs for Growth and Jobs in Europe*. URL: http://www.euromines.org/who_is_downloads/raw_materials_initiative.pdf

is an initiative that is not to everyone's taste. A recent report by The Corporate Europe Observatory has highlighted how the Raw Materials Initiative was being shaped by Members of the European Parliament (MEPs) with vested interests in related industry sectors. Europe's resource grab highlights how key MEPs working on the initiative have pushed for big business to obtain unbridled access to exploit other countries' natural resources, while trying to block measures to protect the environment, community and workers' rights. A number of the MEPs have close links to related industry, including paid jobs and board positions.[47]

The US Department of Energy has also released a report, called *Critical Materials Strategy,*[48] looking specifically into the role of rare earths and other minerals in clean energy and how to consolidate their supply. The Rare Earths Supply-Chain Technology and Resources Transformation Act (RESTART) of 2011 intends to put in place mechanisms to help US manufacturers meet their needs for rare earths metals and ensure US national security needs are met in the near term. In March 2011, four US Senate Democrats urged the Obama administration to use its power to block Chinese mining projects, both internationally and in the US, until *"China agrees to participate fairly in the global trade of rare earths"*.[49] In May, 17 US Senators, representing both Republicans and Democrats, introduced the Critical Minerals Policy Act, which seeks to *"…revitalise the United States critical minerals supply chain and reduce the nation's growing dependence on foreign suppliers"*. The legislation directs the US Geological Survey to establish a list of minerals critical to the US economy and provides a comprehensive set of policies to address each economic sector that relies upon critical minerals".[50] In October, the group RARE (The Association for Rare Earth) was launched by a bipartisan group of senior leaders from the energy, environment and national security fields. RARE seeks to increase rare earth production; remove barriers to access of rare earth domestically and internationally; increase the affordability and trade of rare earth minerals as well as the affordability of technologically and environmentally advanced products made with rare earth minerals.[51]

In Germany, the Federation of German Industries will set up in 2012 the Alliance for Commodity Hedging, whose aim is to help at least 12 major German conglomerates, including BASF and Thyssen, secure raw materials, such as base and rare earth metals, to overcome fears of supply shortages.[52]

Strategic Stocks

- *The* **US** *started a programme of strategic stockpiling shortly after World War II to supply the needs of US national defence. The stockpile contained significant volumes of major metals such as nickel and also metals of less economic importance but of particular significance for the production of war material such as alloying metals.*
- *Like the US, the* **Japanese** *government has maintained a strategic stockpile for many years. At present, the stockpile contains seven metals: chromium, cobalt, manganese, molybdenum, nickel, tungsten and vanadium. The stocks are supposed to cover 60 days of demand by Japanese industry. The aim of the Japanese stockpiling policy of so called "rare metals" is not as militarily focused as in the US, but defines critical metals as those which are essential to industry and subject to supply instability.*
- **China** *is working to establish strategic reserves of 10 rare metals to stabilise their supply and prices, a move analysts said reflects the country's growing concern over scarce resources. The 10 metals are rare earths, tungsten, antimony, molybdenum, tin, indium, germanium, gallium, tantalum and zirconium.*[53]

The Financialisation of Commodities

$60 billion were injected into commodities in 2010, according to Barclays Capital – Why? And where is all this money coming from? The UN recently said in a report that speculation had added 20% to the price of oil. But are banks, hedge funds and pension funds responsible for the rise in oil, copper and wheat prices or are higher prices the logical result of a real, fundamental need for these resources?

Up until a decade ago commodities prices were generally set by trading houses and end users, along with a small(ish) group of specialised hedge funds. In the main, the movements observed on commodities markets, which could be quite volatile at times, were essentially the result of imbalances specific to these markets – oversupply, or lack of demand, for instance. Each one of these markets was de facto isolated from the others. A correlation might have existed between, say, energy markets (especially between oil and gas) but the different commodities markets (energy, food, metals…) were isolated from each other, and from equities, bonds and currencies. But from 2004, this all started to change: new investors arrived into the commodities market using new financial tools. One of the main reasons was because buying commodities appeared to protect them against inflation. Another idea was portfolio "diversification", because commodities had not previously been correlated with other asset classes, such as bonds

47 See: www.corporateeurope.org

48 US department of Energy (2010) *Critical materials Strategy*. URL: http://energy.gov/sites/prod/files/edg/news/documents/criticalmaterialsstrategy.pdf

49 Kosich, D. (2011) 'Senators Ask Obama Administration to Block Chinese Mining Investment'. *Mineweb*. 16 Mar, 2011 URL: http://www.mineweb.com/mineweb/view/mineweb/en/page72068?oid=122996&sn=Detail

50 Kosich, D. (2011) U.S. Senators Introduce Bipartisan Critical Minerals Act. *The Gold Report*. 31 May, 2011. URL:http://www.theenergyreport.com/pub/na/9725

51 RARE (2001) RARE, The Association for Rare Earth, Urges Formation of Senate and House Caucuses to Shape U.S. Policy on Rare Earth Issues. *Rare Metal Blog*. URL:http://www.raremetalblog.com/2011/10/rare-the-association-for-rare-earth-urges-formation-of-senate-and-house-caucuses-to-shape-us-policy-.html

52 Kosich, D. (2011) *Proposed German Industrial Alliance Aims to Secure Critical Metals Supply*. 22 Nov 2011 . Mineweb. URL:http://www.mineweb.com/mineweb/view/mineweb/en/page72068?oid=140136&sn=Detail

53 China Daily (2010) 'Strategic Reserves for Rare Metals Mulled'. Online. November 4, 2010. URL: http://www.china.org.cn/business/2010-11/04/content_21269651.htm

and currencies, or even with each other: better keep your eggs in different baskets, the thinking went. Commodities became part of a much bigger picture and became used as financial tools, part of a portfolio whose management was global. Moreover, the technology to track the markets became increasingly sophisticated. Global economic trends are now much easier to analyse. Trend followers use computer programs using algorithms while "high frequency" traders move in and out of positions in microseconds – the so-called electronic traders. High-frequency trading (HFT) has accounted for more than 60% of shares traded in US equity markets in 2009 and, although less prevalent, is now playing an increasing part in agricultural and metals markets.

After almost ten years of this development, one feature has overwhelmingly emerged: herd mentality. Equities, commodities and credit markets tend to rise and fall together, moving in the opposite direction to safer bets such as US Treasuries. This is known as "risk on, risk off" trade. "Risk off" has involved selling equities, credit and commodities, while buying the dollar and Treasury bonds. This has had the effect of accelerating market movements and volatility, either to the upside or downside, but more importantly it inevitably ends up in creating speculative bubbles. Billions of dollars are moved in and out every month.

Where from? Where to?

The total assets under management in the commodities sector have grown from $10 billion a decade ago to currently more than $450 billion, 50% more than a year earlier. That's a 45-fold increase in just ten years.

One may legitimately wonder where all the money pouring into commodities is coming from. Scale, for one, is a factor. Commodities markets, even the oil market, are quite small in size compared to equity markets. So what may look like relatively small money in the context of the New York Stock Exchange has a huge impact on, say, copper futures traded on the London Metal Exchange. But first and foremost, the main reason for this deluge of money is to be found in the monetary policies of governments in industrialised nations: namely, the prolonged period of low-interest rates and the injection of trillions of dollars into the banking system through so-called Quantitative Easing (QE) policies. Mainly through government bonds, the US for instance has injected $1.8 trillion through QE1 then $600 million through QE2 after the economic crisis of 2008. Institutional investors and pension funds, which were holding the bonds, exchanged them for cash and ended up managing vast amounts of money.

Faced with the prospects of low returns on traditional placements, they first invested their funds in the stock market – indeed data shows that the US stock market was rising when the Federal Reserve was injecting funds, and pausing when the Fed was pausing, then moved on to riskier avenues, such as corporate bond markets, emerging stock markets and commodities markets.

The billions of dollars spent by central banks on their own government's bonds have released a tidal wave of cash that had to find a home.[54] Encouraged by a genuine increase in demand for raw materials, investors have spent massively on commodities markets, in turn artificially contributing to the boom in prices. Gold for instance has gained $270/oz between Ben Bernanke's (Chairman of the Federal Reserve, US Central Bank) first mention of QE2 in August 2010 and the end of the programme in June 2011. Fuelling, too, inflation, with terrible consequences in less developed nations. The story does not end here. There is a genuine risk that several bubbles have been created along the way and, as we have seen so many times before, these bubbles will wreak as much havoc in building up as in bursting.

"It's not about what we need; it's about pure greed. It's the greed of the corporations that want to push consumption of these metals to sell the products they want to sell. And there's a higher level of greed which is being driven by investment. The financial world is turning to metals and minerals as a place for growth and that too is driving mining on a scale that goes way beyond human need."

Vandana Shiva, Director of Navdanya International

54 Inman, P (2011) 'How the World Paid the Hidden Cost of America's Quantitative Easing'. 29 June, 2011. *The Guardian*. URL: http://www.guardian.co.uk/business/2011/jun/29/how-world-paid-hidden-cost-america-quantitative-easing

A standard wind turbine requires several hundred pounds of rare earth elements. And many turbines are necessary to replace traditional fossil fuel or nuclear energy.

Open cast mining/ iStockphoto/ Thinkstock

GREEN ENERGY

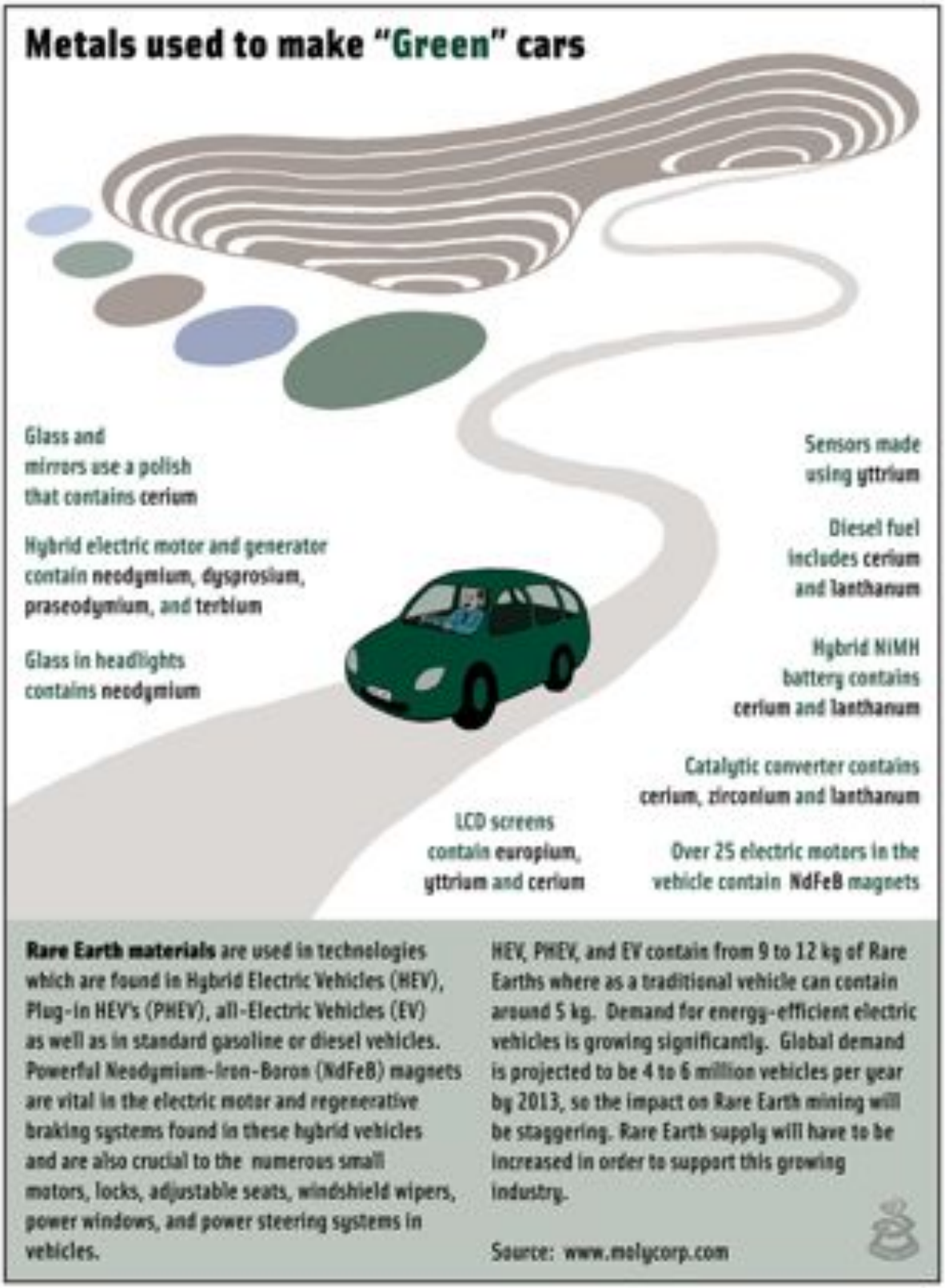

Metals used to make "Green" cars
Glass and mirrors use a polish that contains cerium
Hybrid electric motor and generator contain neodymium, dysprosium, praseodymium, and terbium
Glass in headlights contains neodymium
Sensors made using yttrium
Diesel fuel includes cerium and lanthanum
Hybrid NiMH battery contains cerium and lanthanum
Catalytic converter contains cerium, zirconium and lanthanum
LCD screens contain europium, yttrium and cerium
Over 25 electric motors in the vehicle contain NdFeB magnets
Rare Earth materials are used in technologies which are found in Hybrid Electric Vehicles (HEV), Plug-in HEV's (PHEV), all-Electric Vehicles (EV) as well as in standard gasoline or diesel vehicles. Powerful Neodymium-Iron-Boron (NdFeB) magnets are vital in the electric motor and regenerative braking systems found in these hybrid vehicles and are also crucial to the numerous small motors, locks, adjustable seats, windshield wipers, power windows, and power steering systems in vehicles.
HEV, PHEV, and EV contain from 9 to 12 kg of Rare Earths where as a traditional vehicle can contain around 5 kg. Demand for energy-efficient electric vehicles is growing significantly. Global demand is projected to be 4 to 6 million vehicles per year by 2013, so the impact on Rare Earth mining will be staggering. Rare Earth supply will have to be increased in order to support this growing industry.
Source: www.molycorp.com

fig.3

Runaway CO2 levels and climate change are now firmly at the forefront of international discussions. Moving away from fossil fuels is a priority but so far not much has been achieved in regard to the task ahead. As discussed earlier, 90% of our primary energy comes from fossil fuels and projections by 2030 still give a figure close to 80%. A number of financial incentives and policies have been put in place across the world to encourage the development of so-called renewable energy but the pace is slow and policies are more often than not the victim of politics and hard-nosed financial choices.

China has embraced renewable energy with vigour, as much as any other form of energy, in order to sustain its development and mitigate its heavy coal-induced pollution. It is now the leading producer of wind turbines, with two companies in the top three manufacturers in the world, and solar panels (seven companies in the top ten) but the overall place of renewable energy in its mix is still very low (less than 8% of its electricity is generated by non-fossil fuels). The definition of "renewable" itself is subject to caution. International institutions recognise hydroelectricity as renewable energy but the impact on biodiversity and surrounding communities of big hydroelectric projects is hardly "green" nor soft. There is one aspect of green energy that is hardly talked about though. Solar panels, wind turbines and electric cars are dependent upon a lot of different metals in their design and construction, and if indeed the world manages to move away from fossil fuels to these green technologies, a lot of metals and minerals will be required. Inevitably, while addressing the CO2 issue, these technologies will also translate into an awful lot of mining.

Over 11kg of rare earth minerals are necessary to produce hybrid cars, which is double the amount in a traditional car (see fig. 3). In 2010 72 million cars were produced in the world, out of which only 300,000 were electric cars. If indeed the plan is to convert most cars to electric/hybrid generation, the potential extra need for rare earths minerals is huge.

The story is pretty similar with solar panels and wind turbines, which use the following metals and minerals:[55]

Solar Panels

Arsenic (gallium-arsenide semiconductor); bauxite (aluminium); boron minerals (semiconductor chips); cadmium (thin film solar cells); copper (wiring; thin film solar cells); gallium (solar cells); indium (solar cells); iron ore (steel); molybdenum (photovoltaic cells); lead (batteries); phosphate rock (phosphorous); selenium (solar cells); silica (solar cells); tellurium (solar cells); titanium dioxide (solar panels).

55 See: http://www.mii.org/fact-sheets

Wind Turbines

Aggregates and crushed stone (for concrete); bauxite (aluminium); clay and shale (for cement); cobalt (magnets); copper (wiring); gypsum (for cement); iron ore (steel); limestone (for cement); molybdenum (alloy in steel); rare earth oxides: neodymium, praseodymium, dysprosium, terbium (magnets, batteries); silica sand (for cement); zinc (galvanizing)

A standard wind turbine requires several hundred pounds of neodymium, one of the rare earth elements. And many turbines are necessary to replace traditional fossil fuel or nuclear energy. Scotland is one of the most advanced jurisdictions in that field. According to Scottish Renewables' figures dated 18 April 2011, there were 1,367 turbines in 117 onshore wind projects in Scotland, with a capacity of 2.4GW. Another GW, or a thousand MW, of capacity should be delivered from the 450 turbines under construction. The planning process currently has 2,200 more turbines being considered, with a further 1,600 possible turbine sites being scoped for possible planning applications in the future.[56] That's a lot of turbines – translating into a lot of metals. In December 2010, the US Department of Energy published a report titled *Critical Minerals Strategy*. In it, it estimates the future needs of a range of metals, among them the key elements neodymium, dysprosium and lithium carbonate (used in car batteries). What this report makes abundantly clear is that ambitious plans to switch to green energy will require a massive effort to develop new sources of supply for a number of metals and minerals. In the case of neodymium, the deficit by 2025 could be as high as 40,000 tons in a high scenario trajectory. This is twice as much as the current production of neodymium.

The point that we are making here is not that we should give up on renewable energy technology. Quite the contrary, actually. However, we have to recognise the price that Earth will pay for these technologies if we do not take urgent action to mitigate the consequences.

56 Fraser, D. (2001) *'Reality Check: How many wind turbines*?' BBC News Online. Monday, 2 May 2011. URL: http://www.bbc.co.uk/blogs/thereporters/douglas-fraser/2011/05/reality_check_how_many_wind_tu.html

CONCLUSION

This Report alerts us to the fact that the destruction of the Earth's ecosystems and her communities is spiralling out of control - and must be stopped now.

There is no way that our Earth can sustain 7 billion people, each using 17 tons of materials every year just to live their life. The United Nations Environment Programme (UNEP) says: "How can policymakers (and the public) be convinced of the reality of physical limits to the quantity of natural resources available for human use and that the negative environmental impacts of economic activities also have limits?"[57]

How indeed?

Thomas Berry, cultural historian and geologian, calls for us to learn how to tread softly on the Earth once again. He warns that civilisations which destroy their life support system have all collapsed within a few hundred years.

This implies both a qualitative (the materials we use) and a quantitative (how much we use) change of direction. The world today is only beginning to focus on the qualitative aspect – such as very limited commitments to substituting fossil fuels for green energy. Engineering a change of technology is a necessary condition but it is certainly not sufficient. The production of all technologies needs to be redesigned to maximize re-use, recycling and longevity so that we stop wasting precious materials that cost the Earth. And there is much else that we can do.

However, there is a danger in blindly relying on these green energies and technological fixes to bail us out without simultaneously radically altering our way of life. What we need is a much deeper redefinition of our relationship with the natural world, and this in turn means a thorough examination of our impact on the planet.[58] Our human ingenuity is capable of much, if it is focussed in the right direction. Right now, it is on self – destruct.

The question is how do we change direction before it's too late?

57 UNEP (2011) *Decoupling natural resource use and environmental impacts from economic growth, A Report of the Working Group on Decoupling to the International Resource Panel* , p.51 URL: www.unep.org/resourcepanel/Portals/24102/PDFs/DecouplingENGSummary.pdf

58 We have already exceeded the boundaries of three of nine planetary systems (climate change, biodiversity loss, and excess nitrogen and phosphorus production) according to Rockström, J et al. (2009) *Planetary Boundaries: Exploring the Safe Operating Space for Humanity. Ecology and Society [online] 14(32)* www.ecologyandsociety.org/vol14/iss2/art32. Note proposal by Peter Roderick for a 'Declaration on Planetary Boundaries': http://planetaryboundariesinitiative.org/?page_id=18

Knowing the Story behind Everything we Buy

It is 10.32am on sunny Saturday morning in London and Paul is about to enter his favourite store on Regent Street and browse the new products on display. He last bought an MP3 player 18 months ago and he is now keen to move on to the new smart phone – and on to the latest tablet computer too, if he can afford it.

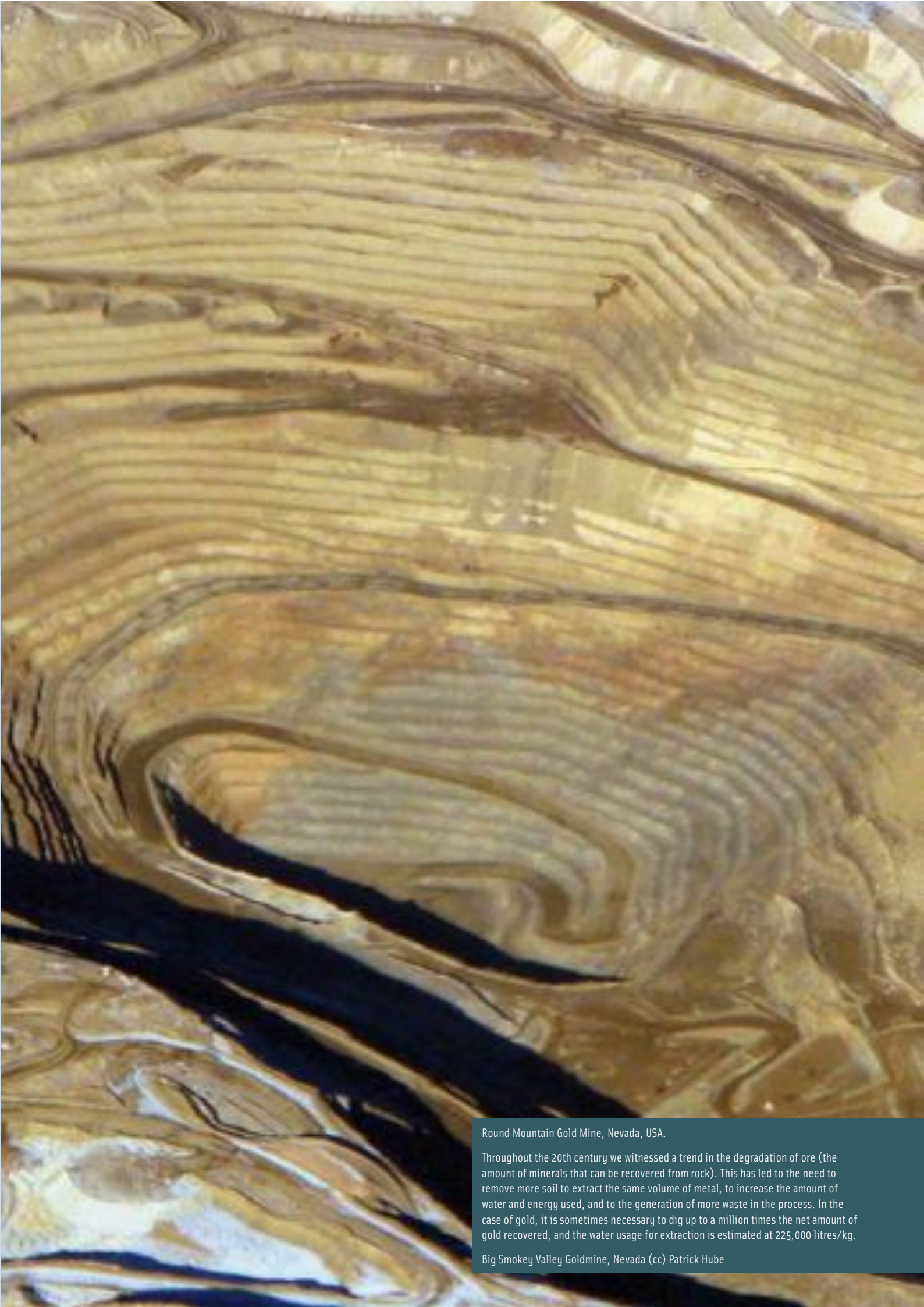
At the other end of the planet, it is dusk and the dust in the air is turning red. Zhao has finished his day mining rare earth minerals in Baotou, the heartland of rare earth extraction. He knows the importance of this industry to his country, China, which controls 90% of the world production, but he is also aware of the terrible environmental price that the communities in Baotou are paying – like the presence of radioactive thorium dust in the air, for instance, or the nearby toxic lake where seven million tons a year of processed rare earths end up, after having been doused in acid and chemicals.[1]

Seen from London, Inner Mongolia in China is a far away land and neither Paul nor Zhao have the slightest idea of the bond that unites them. Yet it is a crucial place for the millions of people who, like Paul, are enthralled by global corporations' endless offers of new products. Indeed, countless technological innovations are now dependent upon rare earth metals whose supply has become one of the most pressing and controversial issues of today.

This is not an isolated story. With the increase in the worldwide population, the growing purchasing power of Asia's middle class and the aspirations of billions of people around the world to emulate a western lifestyle, the demand for 'natural resources' is moving at breakneck speed. In fact one might say that Mother Earth has never before in her history experienced such an assault on her generous gifts to humankind.

The demand is now global. Not only geographically but across a range of produce too. Oil, Coal, Gold, Silver, Iron Ore, Copper are but some of the commodities registering between 30% and 100% price increases in the last few years. Sugar, Wheat, Cotton, Rice have also seen their market value move up sharply, triggering 2011's food riots and unrest, and previously in 2008 just before the financial crisis hit the world. When we realise what is at stake, perhaps we will insist that we know the story of whatever we buy, so that we understand the true cost of our choices?

1 Parry, S. and Douglas, E. (2011) 'In China, the true cost of Britain's clean, green wind power experiment: Pollution on a disastrous scale' The Mail Online. http://www.dailymail.co.uk/home/moslive/article-1350811/In-China-true-cost-Britains-clean-green-wind-power-experiment-Pollution-disastrous-scale.html



Round Mountain Gold Mine, Nevada, USA.

Throughout the 20th century we witnessed a trend in the degradation of ore (the amount of minerals that can be recovered from rock). This has led to the need to remove more soil to extract the same volume of metal, to increase the amount of water and energy used, and to the generation of more waste in the process. In the case of gold, it is sometimes necessary to dig up to a million times the net amount of gold recovered, and the water usage for extraction is estimated at 225,000 litres/kg.

Big Smokey Valley Goldmine, Nevada (cc) Patrick Hube

EPILOGUE

We took this initiative to analyse the trends and dynamics in the extractive industries because communities and citizens around the planet are experiencing how the intensity of land and resource grabbing is reaching fever pitch. As the analysis shows, this is driven by a global momentum. The chips are down. We can dispute some details or choose to deny others, but like lemmings, we are racing towards the cliff consciously or not. We need to wake up and take action.

The reality is that those of us living today will decide the fate of our children like no generation before us. If we are willing to look deeply into the nature of our situation, as the story of Pandora's box recommends, then we will see that we are being seduced by the appearance of things, while beneath the surface what is eating the Earth is eating us too - on many levels.

We have seen how our species has the capacity to destabilise the climate across our planet. So far our cleverness is not matched by our intelligence, nor by our maturity to take responsibility for what we are doing. As Einstein warned, in order to deal with this problem, and change our way of life to diminish our impact, we have to change our way of thinking: *"We cannot solve a problem with the same way of thinking which created it in the first place."*

We have to recognise that every piece of technology is constructed from the precious gifts deep in the body of the Earth, and they need to be treated as such. As Pandora's story warns, the ignorance, arrogance and greed with which we are opening ever deeper wounds in our planet, our source of life, is already unleashing untold misery for the communities on the frontline - humans and other species. Those of us seduced by the latest technological gadgetry need to understand the painful stories behind these machines.

As Gandhi says, there is enough for everyone's need but not for everyone's greed. He also appealed to us not to participate in systems of violence, but to put our energy instead into creating mutually enhancing alternatives.

His moral guidance reminds us that each time we take more than we need, we are stealing from our children. This calls for us to use the intelligence we believe we have, to think much more deeply about our relationship with our planet; what is of true value, what is enough, and how things are produced. And to come to grips with the fact that we live on a finite planet, the only one we know of in the cosmos with life like our Earth.

The choices are now stark. Once enough of us understand, we can work together creatively to find another way. Already social movements across the planet are building alternative pathways. The biggest challenge, as always, is to deal with the huge economic interests and the unaccountable corporate and political system which is driving our addiction to excessive money, fossil fuel and ever more consumption and "growth"[1], which has now reached a level where it is at the cost of Life itself.

Around the world there is a growing movement of communities and concerned citizens responding to the land grabbing by extractive industries. Broadly they are calling for:

1. A Global Moratorium on large scale new mining, extraction and prospecting – so that we can take stock of what we are doing and put our human ingenuity into responsible ways of producing and fulfilling genuine needs. In addition, existing mines need to be evaluated on the basis of their impact on the Earth and communities.
2. Respect for No-Go Zones – ranging from designated areas such as UNESCO sites to indigenous sacred sites and territories.
3. Recognition of the Right of land-based communities to say No to Mining and other Extractive Industries.

Let us remember that when those few people stood up at the time of slavery and said, "Enough is enough, this is inhumane!", they would have been told that they were being unrealistic. The global economy of the time depended on slavery. But enough people had the foresight and determination to bring about its abolition. This is what we need now: what we are doing to the planet has to stop now. Enough of us can make it happen.

Indigenous and local rural communities are bearing the brunt of mining now. But just like climate change, the repercussions are global. They will reach each one of us as ecosystems break down and our life support systems become ever more unstable, as we push our planetary boundaries beyond the limit. This is Ecocide, and our generation will be held to account.

1 Global Witness (2012), *Rigged: The Scramble for Africa's Oil, Gas and Minerals*. URL: http://www.globalwitness.org/library/rigged-scramble-africas-oil-gas-and-minerals

Annex 1: The Story

OPENING PANDORA'S BOX

'Opening Pandora's Box' is a metaphor for our time. It is a story about how one of two brothers, *Epimetheus,* is seduced by appearances and his own desires. He did not have the forethought to look into the true nature of what he saw, or to understand the implications of his actions beyond himself. The moral of the story is that once the Earth is opened, she cannot be closed, and what we spoil we spoil forever. Mining the last remaining wildernesses and the critical ecosystems of our Earth is irreversible. The other brother in the story, *Prometheus*, warns us that hindsight is too late and hoping for the best is ignorant and impotent. What the story recommends is foresight: from this come the gifts of a true civilisation and right relation towards the Earth, our source of life.

* * *

Once upon a time in ancient Greece there were two brothers, grandsons of *Gaia*, Mother Earth: *Prometheus* (whose name means 'forethought' or 'foresight') and *Epimetheus* (whose name means 'afterthought' or 'hindsight').

Zeus, belonging to the next generation, who became king of the gods in Olympus, hid fire from human beings. *Prometheus*, closer to the source, stole that fire back from the gods, concealing it in a stalk of fennel, and gave it to humans. He also taught humans all the civilising arts, such as writing, mathematics, agriculture, medicine and science.

But *Zeus*, in revenge for the theft of the fire, played a cruel trick on humans. He ordered the gods – who did not dare refuse him – to create a beautiful woman in the image of a goddess. *Hephaestus*, the smith god from beneath the Earth, made her from Earth mixed with water; *Athena*, goddess of wisdom, taught her crafts and weaving; *Aphrodite*, goddess of love, gave her irresistible charm; *Hermes*, god of imagination, gave her a deceitful nature, and mischievously called her '*Pandora*' ('*pan*' meaning 'all' and '*dora*' meaning 'gifts'), because 'all her gifts' had been given her by the gods, showing her to be a parody of the only true Giver of All Gifts, who was *Gaia*, Mother Goddess Earth.

Now *Prometheus*, looking in advance into the nature of things, warned his brother not to accept any gift from Olympian *Zeus*, the new patriarch, who was reversing the order of life. But when *Zeus* tempted *Epimetheus* with *Pandora,* he forgot his brother's warning, and took the gift from *Zeus* with great delight. After all, she looked so promising: she was clothed in a silver robe and an embroidered veil; she wore on her head a crown of gold garlanded with flowers and new grown herbs and patterned with the many creatures of land and sea. Gods and mortals were seized with wonder. How could mere humans withstand such temptation?

There was an urn, a mighty jar (only later called a box), which had always been forbidden to be opened, for the sake of the whole world. It contained powers beyond human capacity to understand and control. These are 'all the gifts' of life and death, which *Gaia* alone can give, as 'Mother of All.' But *Pandora,* not knowing what she was doing, seeing it, opened it, and out came all the troubles known to mortals: sicknesses by day and by night, old age, harsh toil and death. Only Hope did not fly out, remaining under the lip of the jar, as *Zeus* had allowed *Pandora* to put the lid back just in time. Yet, before this, the people on Earth lived in peace, free from the suffering that now plagues them.

* * *

This is a tale of 'mythic inversion' – a patriarchal reversal of an earlier goddess myth – where the original awe and respect due to *Gaia* is inverted. Mother Earth was herself celebrated as the Giver of All Gifts in an earlier time when her order was supreme, as *Hermes* recognises in the play upon her name. Now *Zeus*, not *Gaia*, has become the creator, and creates a woman who is the parody of the goddess she is designed to resemble: *Pandora* was a 'beautiful evil,' a false treasure, an inverted image of the feminine. Her superficial outer image is attractive to those who, like *Epimetheus,* have lost the foresight to see into the depths of things. Instead of giving, she takes – as we do – releasing evils we do not understand and cannot take back.

Annex 2:

TABLES AND GRAPHS

All graphs and tables have been reproduced by Camila Cardeñosa from the sources below.

1. Global Material Extraction in Billion Tons 1900-2005
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   IEA (2010) World Energy Outlook. (p.6) URL: http://www.worldenergyoutlook.org/docs/weo2010/key_graphs.pdf

5. IEA Coal-Fired Electricity Generation by Region
   IEA (2010) World Energy Outlook. (p.4): URL: http://www.worldenergyoutlook.org/docs/weo2010/key_graphs.pdf

6. IAEA World Nuclear Generating Capacity
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    Metals Economics Group (2011) World Exploration Trends: A Special Report from Metals Economics Group for the PDAC International Convention. (p.4.) URL: http://www.metalseconomics.com/sites/default/files/uploads/PDFs/wet2011english.pdf

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    Metals Economics Group (2011) World Exploration Trends: A Special Report from Metals Economics Group for the PDAC International Convention. (p.6) URL: http://www.metalseconomics.com/sites/default/files/uploads/PDFs/wet2011english.pdf

16. Rare Earths and Hybrid Vehicles
    Illustration by Stig: www.shtig.net
    Molycorp (2010) Advanced Vehicles. URL: http://www.molycorp.com/GreenElements/RareEarthsManyUses/AdvancedVehicles.aspx (Accessed 16 Feb, 2012)

"What a timely report. No other report to date tackles the thorny issues that plague us; in Europe we are switching from coal to natural gas without any thought for the adverse impact fracking will have upon us all. Our right to life is being put at risk by dangerous industrial activities and no-one is speaking for the Earth. Where our states have the knowledge that industry is causing ecocide, they are under a duty to close down the extractive industries that cause risk of loss or injury to life. This report whistleblows the evidence: no longer can governments claim to have no knowledge of the adverse impact of fracking, land grabbing and mining. This new wave of land grabbing is putting profit above people and planet. Only when we close the door to ecocide will people and planet come first. When we do that the Earth's right to life will be secured."
Polly Higgins, barrister and author of Eradicating Ecocide

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"Over the last 40 years of working with the indigenous peoples in the Amazon in the defence of their cultures and their territories against financial and political threats, we secured their ancestral rights to their land. We always knew that it was an up hill battle and our strategy has been to gain as much terrain as possible and hold out in the hope that the next generation of leaders will be sensitive to environmental and cultural diversity. However the planet is in its worst environmental crisis ever. The forest, which the indigenous people are struggling to protect, is more threatened than ever by a handful of mining companies. What will it take for us to accept that we already know that our political and economic paradigm does not work and is destroying life on the planet? Must we wait until it is to late? Let this report be a wake up call for us all."
Martin von Hildebrand, Director, Gaia Amazonas, Colombia

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"The challenges that we face today in our dysfunctional food system will only truly be addressed when people start to connect the dots beyond agriculture per se. Mining can have a huge negative impact on food availability: when it removes productive farmland from farmers; when it consumes and contaminates vital water resources; when it works hand in hand with the corporations which control the industrial food system that places priority on the large-scale and global markets, not people, ecosystems and sustainability. The warnings of this report must be taken seriously. Organisations and groups of concerned citizens must work together to challenge the startlingly unsustainable growth of the mining industry that feeds avarice, undermining peoples' food sovereignty."
Patrick Mulvany, Chair, UK Food Group

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"This report is coming at the right time. Human beings have almost cleared the surface of the Earth clean and now all efforts are geared towards going beneath the surface – mutilating the body of the very Being that nurtures us. The astonishing truth is that large-scale mining is targeting all parts of the planet, including the sacred spaces which, for millennia, have contributed to maintaining the balance and order within indigenous ecosystems. With this trend, soon the whole Earth will be mined. This report is laying bare the facts and the consequences of the mining dynamics across our planet, and is calling for reason to prevail upon the greed driving this epidemic, to prevent the Earth from reaching her tipping point."
Gathuru Mburu, Co-ordinator, African Biodiversity Network

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"This excellent Report shows how continued and increased extraction of minerals is pressurizing even further those Earth-system processes on which the stability and resilience of life on Earth depends, and impoverishing the lives of future generations. These processes should be recognised and respected, and we are all responsible for safeguarding them. Law has an important role to play in bringing this about and in fostering a harmonious relationship with Nature."
Peter Roderick, barrister, Planetary Boundaries Initiative

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"Opening Pandora's Box is a much-needed uncovering of the mining industry's relentless assault on Mother Nature. Here in Australia, mining interests are protected by Government and sanctified in the country's media. Little truth is revealed of the devastating impacts of mining on the environment and on communities. Brave and unyielding, this report is vital in shining a light on the great juggernaut of the extractive industries, and the tragedy that it is leaving in its wake."
Damien Curtis, Our Generation (Best Campaign Film, London International Documentary Festival 2011)

"This report shows clearly how the game has changed over the last decade: the grabbing of land and resources is penetrating ever more deeply into the body of the Earth. Governments are becoming the shoe-shine boys for the extractive industries. We urgently need to set up an international system which holds those ravaging the planet to account. This is not Nigeria's problem or the Gulf of Mexico's problem; this is everyone's problem. The devastating impact being inflicted on ecosystems and communities must be recognised as international crimes and punished accordingly. Directors of corporations need to be held accountable for the damage they inflict on the planet."

Nnimmo Bassey, Environmental Rights Action, Nigeria,
and Chair of Friends of the Earth International

"If we think of the world as just material and matter, we will plunder, we will grab, and we will fight for ownership. But when we think of the world, as Earth, as the very condition of our life, and we have a creative unity with her, then we will find joy in lowering our consumption. I urge everyone to read this report and open their eyes to the true cost of mining."

Dr. Vandana Shiva, Founding Director, Navdanya, India

"This report reminds us that the increasing level of environmental destruction by the world's mining industry is unsustainable. The result of the massive expansion of mineral exploitation may be short-term prosperity for shareholders and national elites but it comes at the cost of destruction of livelihoods and culture for many of the communities most directly affected and of ecological catastrophe for the planet. We owe it to the communities affected, to future generations, and to the planet itself, to wrest back power from the mining multinationals, massively slow the pace of mining expansion, and move away from a ludicrous economic model that demands that the mining industry behave as if there's no tomorrow."

Richard Solly, Co-ordinator, London Mining Network

"This admirably succinct report speaks with clarity and abundant sense. We stand amidst a convergence of meltdowns - political, economic and environmental. With population growth set to reach the 9 billion mark by 2050 this is a critical moment for radical reflection and reappraisal. Damage on a massive scale, virtually irreparable, is being perpetrated as a result of our insatiable and unending pursuit of growth and profit. The presumption has become irrebuttable that we are negligently at fault. It speaks for itself. The necessary data is all here. Doing nothing is not an option. We must now make amends and initiate change. Before it is too late, the crime of Ecocide should be recognised and placed alongside the other international crimes against peace like genocide."

Michael Mansfield, QC

"The global extractive industries are causing a new wave of landgrabbing on a scale that the world has never seen before. Mining is on the rise everywhere. In the process, wild ecosystems and fertile farm soils get destroyed, water sources poisoned and local communities dispossessed. Read 'Opening Pandora's Box'. When you're finished, you won't be able to just close it and put it aside. You'll have to go out and do something about it."

Henk Hobbelink, Co-ordinator, GRAIN

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