COAL ATLAS

Facts and figures on a fossil fuel

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Coal is pure carbon. It is the most intense carbon miner and transportation of natural resources to Europe. Abiodun Baiyewu-Teru looks at the history of coal mining in Nigeria.

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Not What We Expected

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Nigeria needs a power revolution, but where will the electricity come from? The energy sources in the country are many, including fossil materials such as oil, gas and coal – but renewable energy sources such as solar, wind and biomass are equally available in abundance. The government declared in August 2014 that 30% of Nigeria’s electricity should come from coal. The country has significant coal reserves – currently it is estimated that Nigeria is host to 2.8 billion tonnes of high quality lignite coal, and although this is small compared to lignite top shot North America, which has almost 1.500 billion tonnes of lignite, it is a substantial natural resource lying under Nigerian soils, from the East all the way to the North. But how much of this resource does Nigeria want to extract? Is there a golden rule that says, ‘because you have it, you must use it’?

The implications of using coal for power generation are many, and are hardly discussed in Nigeria. The health implications are the most obvious. Coal combustion accounts for 250,000 deaths per year in China. In Europe, coal-fired power plants cause 2.1 million days on medication, 4.1 million lost working days and 28.6 million cases of respiratory complaints. And that is only on the side of power generation. Before the coal gets to the power plants, the mining operations bear their own kind of hazards. Mining accidents from coal dust explosion, flooding or collapsing shafts make sensational news. Much less light is shed on the permanent impacts coal mining has on host communities, which include loss of farmlands, pollution of ground and surface waters and health problems arising from coal dust inhalation.

Coal is often described as a cheap source of electricity. However, once the health costs, the resettlement of communities, the cleaning up of polluted waters and theclamation of mining areas are counted, coal comes out roughly at the same cost as solar.

Looking at coal through a microscope in a chemical laboratory, what you see is pure carbon. It is the burning of this carbon in coal-fired power plants, during steel production and in many other industrial processes that has accumulated over the past 100 years and is now causing the global climate to warm up and the weather to become more extreme. This has a direct impact on Nigeria’s economic growth. Already, millions of farmers are facing shrinking harvests because their lands are degrading under a scorching sun; fishing villages have been swallowed up by rising sea levels and whole roads and towns have fallen into erosion gullies. It costs trillions of Naira to restore livelihoods and pacify conflicts arising from resource scarcity and migration.

Nigeria would chart a more sustainable economic growth path if it observed very carefully what changes are happening in the global coal landscape, whether cheap coal is really cheap, whether clean coal is really clean, and whether extracting coal really provides a long-term answer to Nigeria’s electricity problems.

This Nigeria Coal Atlas wants to feed facts and figures into the debate around Nigeria’s energy future, and invite readers to reflect on the different options of cutting Nigeria’s megawatt cake into percentages for energy sources such as gas, generators, solar, wind, hydro, biomass... and coal.

Christine K
Director, Heinrich Böll Foundation Nigeria
1 Millions of years of solar power are stored in coal. This energy is released through burning. In the process, large amounts of both carbon dioxide and heavy metals are also released into the atmosphere. This is HARMFUL to the climate and environment – and to our health too.

2 The impact of digging coal is tremendous. Whether in open-cast or underground mines, mining coal DESTROYS nature, POLLUTES water, DAMAGES homes and forces the relocation of entire villages.

3 Coal-fired power plants are not very efficient. Most of the energy is LOST as heat.

4 Emissions from burning coal are increasing in Europe despite its climate policies. Germany, Britain and Poland are the biggest CULPRITS.

5 Nevertheless, coal remains the second-most IMPORTANT SOURCE of energy in the world, after oil.

6 Our governments have committed themselves to protecting the climate. If global warming exceeds 1.5° Celsius, it will be impossible to manage the CONSEQUENCES of climate change.

7 To reach the climate target, 88 percent of all known coal reserves must REMAIN IN THE GROUND.

8 Despite all warnings, coal continues to be SUBSIDIZED. EU member states continue to support coal projects with taxpayers’ money.

9 Private banks finance coal projects worldwide; but in the hope of fighting poverty, development banks also invest PUBLIC FUNDS in coal.

10 The coal industry is well-connected and uses lobbying, generous campaign donations and well-paid climate sceptics TO SLOW the switch to renewable energies.

Worldwide opposition to open-cast mining and other coal projects is growing. PROTEST takes many forms – human chains, blockades, demonstrations and online campaigns.

Creating economies that rely on renewable energy rather than fossil fuels is a major challenge of our time. SOLUTIONS are being sought around the world. They will radically change societies.
HISTORY
THE HISTORY OF COAL IN NIGERIA

Coal was first discovered in Nigeria in 1909 at the Udi Ridge in Enugu by a British mines engineer, Albert Kinson. Kinson had been prospecting for silver. By 1914, the year of Nigeria’s amalgamation, the first consignment of coal made its way to the United Kingdom from the newly created ports at Port Harcourt.

By 1916, the Ogbete Mine was in full operation and in that year alone, it yielded 24,511 metric tons of coal. Over time, other mines sprang up in the region which became the modern day Enugu State. Coal production hit an all-time high of 790,030 metric tonnes before it faced a steady decline due to reasons discussed below, which resulted in many of the mines being abandoned. Currently Nigeria’s coal deposit is estimated at about 2.8 billion metric tons.

Coal for Rail
To manage the resources produced at these mines, the Nigerian Civil War was another major factor in the decline in coal production. But with the sudden discovery of hydrocarbons in the late 1950s, the Nigerian Railway Corporation switched from coal to diesel powered energy. The Electric Company of Nigeria also converted its power generation from coal to diesel. The loss of these two big clients played a major role in the decline in coal production as the government did not think it feasible to continue to heavily invest in the sector. Besides, the recent discovery of crude oil at Oloibiri held the promise of greater revenue from exports for the newly independent nation. The Coal Corporation survived the onslaught of crude oil especially because it continued to enjoy a national monopoly on coal production. The Nigerian Civil War was another major factor in the decline of the Nigeria Coal Corporation. A number of the coal mines became inaccessible during the period and were abandoned. Most of the abandoned coal mines were never revived or reclaimed. Interestingly, two mines were commissioned during the civil war: One at Odagbor, which was later known as the Okaba coal mine, located in present day Kogi State, and the Biafra Coal Corporation in Enugu. Both were merged at the end of the war into the Nigeria Coal Corporation.

Attempts at mechanizing the mines in the late 70s and 80s failed, further plummeting production. Another concern in the 1980s and most of the 1990s was the poor management of the Nigeria Coal Corporation. The then military government had an inclination to randomly appointing personnel with little or no experience in management or without technical knowledge to manage public enterprises. With the appointment of a university professor who had no management experience to head the corporation, its further decline came as no surprise. The final blow was in 1999, when the Nigerian government sought to increase direct foreign investment in the country by privatizing the Corporation and opening the nation’s solid mineral market to large private investors. The strategy failed. With the withdrawal of support from the government, the Corporation lost its steam. It however remained in operation till 2002 before eventually shutting down. Unsuccessful in its privatization bid, the Federal Government in 2013 sold off some of the Corporation’s assets to the Enugu State government in order to offset outstanding debts.
Coal also managed to play a prominent role in Nigeria’s politics in the nation’s early years, post-independence. Having earned Enugu, its position as the Eastern Region’s capital, it subsequently became the short-lived strategic capital of Biafra, during Nigeria’s civil war with the Biafra Coal Corporation providing essential power to the Biafran struggle.

Coal economy at Independence

Coal accounted for a sizable chunk of Nigeria’s revenue at independence and made a major contribution to the development of its national infrastructure. While there are no accurate records of the number of persons employed at the mines for the entire duration of its existence or its dependent economies, what we do know is that it was considered to have provided employment for a sizeable population of people and that the final demise of the Nigeria Coal Corporation impacted commercial activities in the city. As a mining town, Enugu attracted local, national and international migrants who worked at the mines and provided it with flair and colour. The city’s population in 1952 was estimated at 62,000, of which more than half were non-indigenes. A traditional ruler who witnessed the coal era boom, testified that virtually every family in Enugu had at least one member working at the Corporation and that the mines had a large and independent economy. Later, when crude oil took over from the revenue derived from coal, its impact was less felt on a national scale.

While the benefits of the coal mines were largely economical and immediate, it also had negative and long term effects, especially on the environment. These effects are particularly compounded by the failure of the government to reclaim most of these mines – especially those abandoned during the civil war. Enugu state is reputed to have the worst erosion in the entire nation – a condition attributable to unreclaimed mines and unregulated artisanal mining at abandoned mine sites throughout the state. A study by the Journal of Environmental Science and Technology on the effects of mine drainage on water bodies, specifically looking at coal mining in Enugu concluded that “the quality of the water is significantly influenced by acidic mine drainage and its impact on human health could be severe.” There are currently over 22 redundant coal mines around Nigeria, 14 of which have been abandoned. In the city of Enugu, it is hard to distinguish the site of the Iva valley massacre monument in Enugu, Photo: hbs Nigeria

CLIMATE CHANGE
A 2 DEGREES WARMER NIGERIA

Coal is pure carbon. It is the most intense carbon emitter. How will Nigeria look like in a decade or two, if carbon emissions continue unabated and if the planet warms by 2 degrees Celsius? Christine K of the Heinrich Boll Foundation Nigeria has compiled these snapshots of how climate change is already affecting Nigeria today, from north to south, and what is to come if carbon emissions continue to rise.

There are a few key points about climate change. First, it’s not just about the temperature. There are also changes in rainfall patterns and extreme weather events. Second, it affects all sectors of the economy, but particularly those that are sensitive to changes in climate and weather patterns, such as agriculture and tourism. Third, it exacerbates existing inequalities and vulnerabilities, particularly in poor and marginalized communities.

The event catalyzed mass protests in other cities including Port Harcourt, Aba and Onitsha. According to political scientist Richard Sklar, “Historians may conclude that the teaching of Nigeria’s history.

The Iva valley massacre monument in Enugu

Photo: hbs Nigeria

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Coal is formed from vegetation at high temperatures and pressures, cut off from the air. The older the coal, the more carbon and energy it contains. Deposits are located in all continents. Coal is a brownish to black sedimentary rock made up of organic material. It was formed in the Carboniferous, a period that lasted 60 million years and spans from about 359 million to 299 million years ago. The name “Carboniferous” comes from “carbo”, the Latin word for coal, because so much of this type of rock dates from this period. The Latin in turn comes from the presumed Indo-European word “karō”, meaning “burn”.

The climate was generally warm in the Carboniferous, and the atmosphere was richer in oxygen – 35 percent, compared to just 21 percent today. That stimulated the growth of plants. Vast forests spread over the land surface. A now-extinct tree known as lepidodendrales (from the Greek for “scale tree” after the appearance of their trunks) grew up to 40 metres tall. Relatives of horsetails, now inconspicuous plants that grow on the edges of fields, reached 20 metres in height.

When the vegetation died, the process of coal formation began. Many dead plants sank beneath the water, where they did not rot because of the lack of oxygen, but formed peat. Sediments such as clay or sand were deposited on top, raising the pressure and heat and squeezing out the water. As the carbon content of the organic layers increased, the peat turned into denser, firmer lignite, or brown coal. Hard coal is much older – around 250 to 350 million years old. Lumps of this coal still bear the imprints of past vegetation. Most hard coal has a moisture content of 15 to 20 percent.

The more carbon coal contains, the more energy and the higher its calorific value – its value as fuel. So hard coal is preferable to brown coal. The best type is known as anthracite, which contains very little water or other ingredients. The only minerals that have more carbon are graphite and diamond, which are both usually of volcanic origin.

Ultimately, coal is energy from the sun, preserved in the form of plant remains. The historian Rolf Peter Sieferle refers to coal as a “subterranean forest”. Along with oil and natural gas, lignite and hard coal are fossil fuels. The term “fossil” indicates that they were formed from organic materials in the geological past. Coal and lignite come from vegetation; oil and natural gas are the remains of tiny organisms that were deposited on the sea floor. They were formed between 400 and 100 million years ago – at around the same time as hard coal. More recent deposits, such as those in the North Sea, were, like lignite, formed in the Palaeogene.

The German Federal Institute for Geosciences and Natural Resources estimates the world’s coal reserves at 968 gigatonnes (968 billion tonnes). It classifies reserves as deposits that can be exploited economically and profitably using current technology. In 2013 alone, humankind mined and burned 8 gigatonnes, or 253 tonnes every second. In addition to the reserves, the Earth has vast deposits of coal that have been proven but are currently uneconomic to exploit. Altogether, it is estimated that global deposits of lignite and hard coal may amount to 22,000 gigatonnes.

The largest deposits of the economically more important hard coal are found in Asia, Australia, North America and the Commonwealth of Independent States, an organisation of former Soviet Republics. The United States has the biggest reserves of hard coal and anthracite, with 223 gigatonnes. China comes next, with 121 gigatonnes, followed by India, with 82. In 2013, China dug up 3.7 gigatonnes of hard coal, more than half the world’s total output. The United States followed with 12 percent, and then India, with 8 percent. About 20 percent of the world’s hard coal output is traded internationally.

Lignite, on the other hand, is difficult to transport and contains less energy, so it is used as fuel only in the immediate vicinity of the open-cast mines where it is extracted. Some 37 countries around the world exploit lignite, but only eleven account for 82 percent of worldwide production. The biggest producer in 2013 was Germany, with 181 million tonnes, followed by China and Russia. Germany’s lignite production has risen sharply after the country’s move away from nuclear power. This has significantly worsened its carbon footprint. In 2014, renewables overtook lignite as Germany’s most important source of energy, but only by a small margin.

Unlike oil, there is no official shortage of coal. In the long term, output will decline because the atmosphere can absorb only so much carbon dioxide. However, the Energy Watch Group, an international network of specialists, thinks that official estimates of coal reserves are too high. The global estimates are continually being revised downwards – between 1980 and 2005 by about half, despite higher figures for India and Australia. The group expects we will reach peak global coal production as soon as 2020.

**Dry Goods in Demand**

<table>
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<tr>
<th>Quality of Various Types of Lignite and Hard Coal</th>
<th>Total Water Content*</th>
<th>Energy Content a. f.*</th>
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<tbody>
<tr>
<td>Peat</td>
<td>75</td>
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<tr>
<td>Ortho-Lignite</td>
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<td>38,000</td>
</tr>
<tr>
<td>Anthracite</td>
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<td>50,000</td>
</tr>
</tbody>
</table>

* a. f. = ash-free

**Bursting at the seams**

Deposits of hard coal and lignite

Once upon a time, a map of coal deposits reflected natural wealth. Now it shows where problems may lie.
GREENHOUSE GASES

SPOLIOING THE CLIMATE

Digging up coal and using it to generate electricity churns out emissions that intensify the greenhouse effect. Coal is one of the biggest sources of climate change.

Greenhouse gases occur naturally in the atmosphere. They absorb part of the energy from the Earth’s surface and from clouds, preventing heat from escaping into space. Without this so-called greenhouse effect, the Earth would be a lot colder than it is. But since the Industrial Revolution, we have added sharply to the amount of carbon dioxide, methane and other greenhouse gases in the atmosphere: levels of CO₂ in the air have gone up from 288 to 395 parts per million. Such concentrations boost the greenhouse effect.

The average global temperature has risen by 0.85 degrees Celsius since temperature records began. That may not sound like much, but the effects on our climate are considerable. Extreme weather such as droughts and heavy downpours are increasing. The mean sea level has risen by 19 cm since 1901. The Arctic ice pack is dwindling, the Greenland ice sheet has lost considerable mass, and glaciers worldwide are shrinking.

No other source of energy contributes as much to greenhouse gas emissions as coal. In 2014 it was responsible for over 28% of all energy-related carbon dioxide emissions, and more than one-quarter of all greenhouse gas emissions.

The 35 biggest coal producers have been responsible for one-third of the global emissions since 1988. This was the year the Intergovernmental Panel on Climate Change was founded, and the Toronto climate conference requested governments to set targets for reducing their emissions. The coal industry could no longer deny the harm its product was causing. Private companies, state-owned enterprises and government-run industries have made huge profits from producing and selling coal. But they have not been held accountable financially or legally for the loss and damage they have caused, and continue to cause, around the world.

The majority of coal is burned to produce heat and electricity. That releases a lot of carbon dioxide, along with smaller quantities of methane (CH₄) and nitrous oxide (N₂O). Different greenhouse gases have a different impact on the climate; converting them to a “CO₂ equivalent” measure makes them comparable.

The amounts of CO₂ and other greenhouse gases that escape into the atmosphere for each kilowatt-hour of electricity produced depend on the carbon content of the coal and the efficiency and operations of the power station. Only about one-third of the heat generated from burning is converted into electricity by turning water into steam that spins a turbine. A critical question is whether the power plant uses the residual warmth for heating purposes, or whether it merely releases it into the environment. In general, generating electricity from coal damages the climate most; gas-powered plants emit only half as much CO₂ as modern coal-fired power stations.

The carbon footprint of coal is further enlarged by emissions of mine gas. This is created during the formation of the coal, and consists mainly of methane. In 2010, mines added the equivalent of another 500 million tonnes of CO₂ to the atmosphere. In addition, hard coal often has to be transported long distances. That involves energy and contributes to the climate damage. Burning coal, whether in a power station, furnace or stove, releases soot particles that also fuel the greenhouse effect. Mining and transporting lignite produces fewer emissions. But using it to generate electricity still harms the climate more than hard coal. This is because lignite is less compact: it contains less energy - more has to be overburdening the atmosphere.

The West Antarctic ice cap might melt. Such temperature thresholds are known as climate “tipping points”. Beyond the tipping point, the climate would not return to its current state, but would undergo further changes that are impossible to predict.

Like there is no tomorrow

The world’s 35 largest private or state-owned coal producers by carbon dioxide and methane emissions, cumulative 1988-2013, in billion tonnes of CO₂ equivalent*

Private firm (national)
Private firm (multinational)
State-owned company
(former) nationalized industry

The Intergovernmental Panel on Climate Change is founded, and the damage caused by CO₂ can no longer be denied. But the coal producers are not too worried.
Outside the traditional coal areas in Eastern Nigeria, coal is also found in Kogi State. Okobo, a small town in Enjema District of Ankpa Local Government Area, has reserves of up to 380 million tonnes of coal. Abiodun Bayewu-Teru, Executive Director at Global Rights Nigeria, describes the human rights perspective of coal mining in Nigeria.

The Nigerian Mineral and Mining Act of 2007 makes it compulsory for mining companies to seek social license for their activities from their host communities and to reach a community development agreement (CDA) with them before a mining license is issued. Yet, there was no documentary evidence of a CDA reached between Zuma Energy and Okobo community. Evidence of its existence became even more confusing when neither the company nor the community representatives could provide one. In a separate interview, Ambassador Joseph Ayalogu, the Corporate Relations Director at Zuma Energy, explained that a community development agreement existed, but only as an addendum of some sort to a lease agreement signed by both the company and the community. The community however insisted that they had never seen a copy of the signed agreement and that they had no knowledge of the parties who were signatories to it. They insist that their agreement with the company had been oral.

According to Ambassador Ayalogu, "But the Ministry of Mines has a new approach...there should be a standalone CDA, which we have already prepared and sent to the community". At the time of writing this article, the newly prepared community development agreement was also in contention as the community leaders insisted that they had never received it.

The primary school classroom in which Okobo community members had gathered to discuss their plight, is the core tangible community development project undertaken by ETA Zuma Group. The primary school building boasts of six sparsely furnished classrooms (which was still of better quality than government built schools in the state), two laboratories and an overhead water tank which supplied the water needs of the school and recently had been extended to the community after the pollution of their stream. The water which filled the overhead tank was supplied by a water tanker truck with which the company fetched water from a neighbouring source. While grateful for the school block, Okobo’s indigenes insist that the building was only constructed to replace a previously existing one which collapsed due to strong vibrations from the company’s large excavation tractors. ETA Zuma Group claimed that the former school building’s foundation was already defective and was destined to collapse in any event. According to the community, the collapsed school building killed a pupil who was buried in its rubble. The community’s paramount chief, who had been the deceased pupil’s guardian till his tragic death, said that the company was yet to officially acknowledge the incident or offer any form of compensation to them. The government claimed no knowledge of the event.

At the inception of the coal mine operations in 2011, residents of Okobo community had such great expectations. According to them, they were promised the mines would bring numerous job opportunities and would radically improve their standards of living. Four years on and 30,000 metric tonnes of excavated coal later, only 14 members of the community had been employed by the company. The number of indigenous people employed by the company represents only a small fraction of the total staff strength of over a hundred people. Counting of the tips of his fingers, the paramount chief acknowledged the number of local residents
who had been employed by the Mine. “We have 14 people working in the company - 3 are drivers, 2 are helpers, 3 are cleaners and the rest are security guards”.

“Too much dust!”

The environmental degradation they suffered from as a result of the mines operations was another source of contention for the community. “Dust! Too much dust! Once they remove and lift the coal, the entire village is covered in coal dust. The roads too are very dusty. When their big tractors run at top speed, we are covered in dust.” According to the community, there had been a definite increase in respiratory diseases since the Zuma Energy commenced its operations.

The dust emanates not only from the lorries trawling the uncharted roads around Okobo, but also from the grinding of the coal within Okobo. Once the coal from the pit is ground in Okobo, it is then transported in lorries to neighboring Okaba, where a factory presses the powder into briquets used for cooking.

There has been no official survey of the health impacts of the coal mining operation on the community so far. Without such a baseline survey, the community has no scientific evidence to defend their claim that the mine is affecting their health. But a global comparison indicates that people’s health is at stake in Okobo. Statistics from Mpumalanga Province in South Africa, which has a long history in coal mining, show that inhaling the dust from coal pollutants is instrumental in the development of chronic obstructive pulmonary disease (COPD), a lung disease characterized by permanent narrowing of airways and quite common in coal mining host communities. Trace amounts of mercury in coal dusts affect the nervous system and can cause loss of intellectual capacity. Studies in Mpumalanga have shown the relation between coal mining and stunted growth in children. The correlation between coal mining and asthma in mining host communities has been established in several countries including the US where environmental pollution regulation is much stricter than in Nigeria. Many community members in Okobo are not aware of these potential consequences. To make matters worse, community members have no health care facilities in Okobo. The two clinic run by ETA Zuma Group is reserved exclusively for its staff.

Contaminated stream

But the biggest problem for Okobo citizens is water. Before the coal mine opened, residents were fetching water from the stream that runs through the village. The coal mine has changed all that as the excavation activities within the 5-meter deep open pit affect the ground water. ETA Zuma Group’s surface mining operation consumes large volumes of water and excavation activities have possibly disrupted the water bed in the community. The contaminated residue water from the activities find their way back to the community through the stream that runs through the village. “Distance from the activities to the nearby water bodies is minimal. As a result, the contaminated water finds its way back to the communities to fetch water for their consumption. According them, the water from their stream has become so bad that they cannot use it even for their laundry. A scientific analysis commissioned by Global Rights also revealed that their water’s turbidity and chemical content was higher than the World Health Organization’s recommended levels for human consumption. Turbidity is the cloudiness or haziness of water and excavation activities have possibly disrupted the water bed in the community. The contaminated residue water and excavation activities have possibly disrupted the water bed in the community.

A new start

According to the community’s leaders, the oral MoU between the company and the community expires in 2016 and will need to be renewed. This would give them an opportunity to negotiate a better deal and also to ensure that this time around, they have proper representation at the negotiating table - something that they lacked during the previous negotiation four years ago.

According to Gago Maijadah, a community elder, the people who had negotiated and signed the CDA on their behalf did so for their own selfish interests. Maijadah argues that those people were not from the core clans that were affected by the mining activities, even though they come from the area. Speaking in his local dialect he says, “Their water is safe for them to drink, their land is arable for them to farm. The real people who are affected are ignored and the company seems not to understand”.

While they were largely disappointed, the community still credits the company for fulfilling some of their statutory obligations. For example, according to them, the company has never defaulted in meeting its annual obligation of paying surface rights to the land owners. They had put up a new school building for the children, provided a monthly stipend for the administration of the school and leveled the major road leading to the community. “It is not like we are ungrateful with what the company has done,” says Mr. Idris Ibrahim. “Things are just not the way we expected.”

Exposed water in Okobo coal mine pit

More scenarios of how Nigeria will look like when global temperatures would have risen by 2 degrees Celsius as a result of increasing carbon emissions

CLIMATE CHANGE

A 2 DEGREES WARMER NIGERIA

More scenarios of how Nigeria will look like when global temperatures would have risen by 2 degrees Celsius as a result of increasing carbon emissions

AGRICULTURE IMPACT

They might not know that global carbon emissions are the cause of their problems, but millions of Nigerian farmers – both women and men – are living the reality of climate change in form of degrading soils, diminishing harvests and resulting hunger. With further increases in carbon emissions, food security will be under extreme stress in Nigeria as large areas of land will become useless. Long-term records show that over the past 105 years, the average amount of rainfall per year dropped by 81 mm. As temperatures increase, agricultural outputs decline because of high evaporation rates, reduced soil moisture, lowering of the groundwater table and shrinking of surface water. Heat stress reduces farmers’ productivity and leads to rapid deterioration and wastage of farm produce. The biggest obstacle, however, is lack of knowledge on how to adapt to the changing climate – only 5% of Nigerian farmers have access to improved, climate resilient seeds. Bush burning remains a significant source of carbon emissions and is the no.2 emitter in Nigeria, after gas flaring in the Niger Delta.

FLOODING

Global warming has raised global sea level about 8 inches since 1880, and the rate of rise is accelerating. Rising seas dramatically increase the odds of damaging floods from storm surges. A Climate Central analysis found that the likelihood of damaging floods from storm surges is projected to increase by 12% every decade as the rate of rise accelerates. Rising seas dramatically increase the odds of damaging floods from storm surges. A Climate Central analysis found that the likelihood of damaging floods from storm surges is projected to increase by 12% every decade as the rate of rise accelerates. Under a 2 degree global warming scenario, coastal areas such as Lagos and the entire coast of West Africa would be under water. Under a 4 degree global warming scenario, a huge area of Lagos would be under water, from the Lekki Free Trade Zone and its new deep sea port (currently under construction) all the way north to Surulere and Lagos Mainland. The catastrophic flooding of 2012 will repeat itself many times over, as rivers suddenly swell with excessive rains.
Coal extraction has huge impacts on the environment. In open-pit mining, which accounts for about 40 percent of global coal production, the entire overburden has to be removed to reach the coal seams underneath. The landscape is completely destroyed. Communities are removed, plants and animals are eliminated, and the living soil is shovelled away. Excavators dig enormous craters, hundreds of metres deep. Appalachia, in the United States, has a particularly extreme form of open-pit mining: to get at hundreds of metres deep. Appalachia, in the United States, the coal, entire mountaintops are blasted away and the rubble is dumped in the valleys.

Our planet is littered with thousands of coal mines. The largest mine in the world, measured in terms of reserves, is the North Antelope Rochelle Mine in Wyoming, in the western United States that is estimated to hold some 2.3 billion tonnes of coal. It produces over 100 million tonnes annually from a vast open pit covering 250 square kilometres. The second-largest operation is the Haerwusu Mine in Inner Mongolia in China. This mine has an estimated 1.7 billion tonnes of reserves and an annual output of 20 million tonnes. It covers over 67 square kilometres. Other mega-mines can be found in Australia, Colombia, Indonesia, Mozambique, Russia and South Africa.

The ecological consequences are similar across countries, though standards for mining, restoration and legal enforcement differ widely. Mining means digging up and shifting huge amounts of earth. In some types of soil, iron and sulphur compounds can oxidize to iron and sulphate when they come into contact with the air. After extraction ceases the groundwater levels rise again and sulphuric acid is produced. As a result, the flooded pits and groundwater acidity. Adding alkaline materials such as limestone can reduce the level of acidity but cannot prevent it completely. Some of the iron that is set free is converted to iron hydroxide, or limonite. This rust-coloured mineral clogs pipes and pumps, blankets the spawning grounds of fish, and smothers their food supply.

Pumps are used to lower the water table and prevent the pits from filling up with water. This has severe consequences for the groundwater. In Germany’s largest open-pit mine, at Hambach, this will require pumping out almost 45 billion cubic metres of groundwater over the next 60 years. If the mine is expected to be in operation. Keeping a mine dry disrupts the hydrology of the neighbouring areas: lowering the water table by as much as 550 metres dries up the springs that feed rivers, kills trees, desiccates wetlands and reduces biodiversity. This pumping, or what the experts call “mine dewatering”, may also dry up wells, endangering drinking water supplies. It can take hundreds of years for the ground-water level to regain its previous level.

Mozambique’s Tete province used to be famous for its beautiful baobab trees, many over 1,000 years old. But coal-mining companies have destroyed vast numbers of them, ignoring their importance for the environment, local culture and peoples’ diets. Such trees may take hundreds of years to regrow. Clouds of coal dust, polluted water and soil contaminated by acid drainage from mines also harm local communities. None of the companies operating in Mozambique have published environmental management plans, leaving the public ignorant of the environmental consequences of their operations.

In Nigeria, the government has signed a memorandum of understanding with the Chinese firm HTG-Pacific Energy to exploit coal in Enugu, in the southeast of the country. But no environmental impact assessment has been made – though this is required by law – and the right of affected communities to be involved in the project development has been ignored.

Cerroponi, a massive open-pit mine in Colombia, has impoverished the surrounding soils and contaminated or dried up water sources, with devastating impacts on farming and livestock keeping. The whole mining complex here extends over 69,000 hectares. Ninety percent of Cerroponi’s hard coal is shipped abroad to fuel power plants, mainly in Europe and in the United States.

While becoming the world’s largest coal exporter, Indonesia has destroyed vast areas of rainforest and deprived local people of their land and homes. In Borneo, the indigenous Dayak people are fighting against mining companies’ activities, particularly against the mining giant, BHP Billiton. The Dayaks are trying to stop a series of large coal mines and railways that would decimate primary rainforest, pollute water sources, displace indigenous peoples and endanger orangutans. This project would destroy the headwaters of 14 major rivers that provide clean water to 11 million people.

Coal mining leaves its mark on the landscape in other ways too. Lethal landslides can occur in open-cast pits decades after mining operations have ceased. Underground mines cause surface subsidence that damages buildings and roads. These “inherited liabilities” will continue to be a burden to future generations. In the Ruhrgebiet, a mining and industrial area in western Germany, water has been pumped out of abandoned underground pits to stop the water table from rising too high, and in some areas continuous pumping is needed to prevent entire neighbourhoods from being flooded.

The ash from power plants also gives cause for concern. Landfills that store this toxic by-product of coal burning are often inadequately secured, allowing the ash to leak out. A particularly serious case occurred in 2008 in Tennessee, in the eastern USA. A retaining dam next to the Kingston coal-fired power station collapsed. Four million cubic meters of ash sludge containing heavy metals were released, carpeting the surrounding areas and polluting a nearby river.

In Australia, the government wants to ship more coal to China and India. More mines, more ports – Australia wants to ship more coal to China and India
Smoke and fumes from coal-fired power plants make us ill. They are responsible for hundreds of thousands of deaths worldwide each year. Atmospheric and environmental pollution from coal costs billions in health expenses.

8,500 people are diagnosed with chronic bronchitis a year because they come into contact with pollutants from coal plants. If power plants in Croatia, Serbia and Turkey are included, the number of deaths in Europe rises to more than 23,000 a year. HEAL calculates that the health costs add up to almost 43 billion euro a year. These high health costs ought to be included when comparing the prices of various sources of energy.

The amounts of emissions depend on the filtering systems the power plants use. Although these have improved considerably in recent decades, coal-fired plants are still responsible for releasing 70 percent of the EU-wide emissions of sulphur dioxide – a particularly important class of fine particles – along with half of the industrial mercury emissions.

When fine particles are inhaled, they penetrate the lungs and bloodstream, causing various harmful effects on the body. They can cause chronic inflammation of the lungs, impair the pulmonary reflexes, and reduce the functioning of the lungs. That can lead to diseases such as asthma, chronic bronchitis, and in the long term, lung cancer. Another effect is reduced blood flow to the brain because the blood coagulates faster and can carry less oxygen. High blood pressure, irregular heartbeat and heart attacks may result. There is no official limit below which fine particles are considered harmless.

Children are especially vulnerable to the harmful effects of heavy metals in emissions: lead, mercury, cadmium and arsenic. If their lungs are damaged early in life, they may become permanently weakened. While still in their mother’s womb, children who are exposed to large amounts of lead or mercury risk developing cognitive disorders and often have lower IQs. They may also suffer irreversible organ damage.

Measurements show that power stations with especially high carbon dioxide emissions also emit many other toxic pollutants. If less CO₂ is released, the emissions of sulphur dioxide, nitrogen oxides and fine particles also fall. That is why the American Lung Association supports President Obama’s climate change plan, which aims to reduce the emissions from new power stations by around one-third.

But the burning of coal is only one health hazard: mining is harmful too. People living near open-cast mines are exposed to high levels of particulate matter, which can lead to respiratory diseases or allergies. Mine tailings contain heavy metals and other toxic substances that can enter the groundwater and air.

Radioactivity is another problem. Lignite contains uranium, thorium and potassium-40. In the Rheinland, Germany’s largest open-cut mining area, 100 million tonnes of lignite and 460 tonnes of overburden are excavated each year. Friends of the Earth Germany estimates that this includes 388 tonnes of uranium. These radioactive substances are also present in the airborne dust and find their way into people’s lungs – with incausal consequences to their health.

Such health problems are particularly evident in the Mpumalanga Highveld coal-mining area in South Africa, home of 12 of the largest coal-fired power stations in the world. Toxic substances and waste water from the open-cut mines contain the limited amounts of drinking water in the area. Local people have little choice but to consume it. Research by Friends of the Earth South Africa indicates that coal is responsible for half of the deaths caused by respiratory and cardiovascular diseases in the region. Respiratory problems such as asthma and whooping cough are widespread among local people. Children and elderly people are especially at risk. Most of the power plants do not have to comply with national clean air standards – for cost reasons.

The permissible limits for pollutants vary widely from country to country. The United States has significantly stricter mercury and sulphur dioxide limits than the European Union. As a result, many coal-fired power plants there have been closed or retrofitted.

Climate change caused by using coal is an indirect threat to human health. In June 2015, a Lancet Commission of international health experts warned about the health consequences of global warming. The last five decades of development and health advances could be nullified. The commission pointed at the dangers posed by air pollution, increasing temperatures, and extreme weather. This included increasing heat stress, the spread of infectious diseases such as malaria and dengue, threats to food security, malnutrition, and a rising number of refugees and armed conflicts.
Although coal production is still on the rise, the sector is employing fewer people. Structural change has spread to all continents. Nevertheless, mining underground remains one of the most dangerous occupations worldwide.

In 2012, an estimated seven million people were employed in the coal industry, most of them in coal and lignite mining. That number is likely to be lower in 2015, with employment falling especially in China. The world’s largest coal producer is beginning to exploit its reserves more efficiently, however, it still needs many more workers than the United States, where modern equipment and optimized operations enable about 90,000 people to mine 0.9 billion tonnes, mainly in open-cast mines. In China, 5.7 million people are needed to dig out 3.7 billion tonnes, mainly from underground mines. In the United States 10,000 jobs were lost in 2013 alone, partly because the shale-gas boom has made coal production less profitable.

Fewer workers are needed in countries where productivity is rising quickly. For example, the Chinese government has closed thousands of small, inefficient mines. India also needs fewer workers to produce the same amount of coal. Coal India, the state-controlled producer, slimmed its employee rolls from 500,000 in 2005 to 350,000 in 2014. In the European Union is also cutting thousands of jobs in the coal industry, and do not include the related project developments, transport and power-plant operations.

Despite such uncertainties, it is still possible to discern some trends. China is the leading power in renewable energy, employing 2.6 million people in 2013. Most jobs can be found in the production and installation of renewable-energy plants. Brazil follows with around 900,000 jobs, the USA with 600,000 and India with 400,000. Germany is fifth. Its employment in renewables has doubled since 2004; by 2013 it had reached 370,000. By comparison, the German lignite industry directly and indirectly employs 70,000 people.

Working conditions in the renewable sector are generally better than in coal, although the renewables still entails risks, as in the chemicals companies that make solar cells. But workers in coal mines are subject to much greater risk to life and limb. And to their lungs, where the coal dust settles causing chronic diseases. Mining accidents are often dramatic, claim many lives, and attract a lot of publicity. With 150 years of experience underground, the coal industry has a deep understanding of the risks, and has detailed regulations to prevent accidents. If accidents occur, they are usually due to safety precautions that have been ignored in order to save costs, to negligence, or to equipment failure.

The situation in China, which accounted for 80 percent of worldwide deaths in coal mining, is improving. The small mines that are being closed are also the most dangerous. In the 1990s, 5,000 to 7,000 miners died every year. In 2010 the figure was 2,400, and 930 in 2014, according to government data.

In the western world, the image of a miner is still one of a hard-working, sober-covered man. And indeed, in Europe or Canada – and also in India – women still account for less than 20 percent of the workforce. In the ex-socialist countries, however, more women go underground. In many parts of the world it is not easy for women to work in the coal industry. And if they do land a job, they are usually paid less than men and have to fear sexual assault in the mine.

According to a Greenpeace study, the coal industry will not comply with the safety rules because the operators do not recognize the risk of safety violations. The small mines often lack the necessary safety measures and equipment, and do not invest in safety training. The situation is similar for the large mines, which also have a high accident rate.

Many mining accidents happen because the operators do not comply with the safety regulations.
Christine K, Heinrich Böll Foundation Nigeria (hbs): ETA Zuma is investing in coal fired power plants in Kogi State. When will Nigeria get its first megawatt from a coal power plant?

Ambassador Joseph Ayalogu of ETA Zuma Energy: Well, we have a 1,200 megawatt power plant license for Itobe, which will be broken into our modules of 300 megawatts each. The financing will come from both local and international investors and of course the beauty of it being a private sector driven activity is that one has to be efficient to make profits. Let’s assume we start construction next year with the first tranche of 300 megawatts. It takes approximately 30 months to complete and roll into action, so we are looking forward to actualizing the 1,200 megawatt limit within the next 5 years or so.

hbs: Let me turn to Niminho Bassey - you’re known to advocate for “leaving coal in the hole”. Would you rather leave all Nigerian coal in the soil and not have electricity?

Niminho Bassey of Health of Mother Earth Foundation: The whole world knows we are facing a climate crisis, if we exploit coal, keep on exploiting oil and gas, and keep on burning them, then we are burning our future and that future that is getting very near, it’s not a distant future. I’m really surprised to know Kogi State is taking on energy sources that are actually questionable. For example, there is a proposal to establish two nuclear power plants in Nigeria, one in Kogi State and one in Akwa Ibom State, and this is completely outrageous. Coal may not be as dangerous as nuclear power observed, but having coal power plants and nuclear power in Kogi State? Oh my goodness, I don’t know what is going to happen to Kogi State.

hbs: So what solution do you prefer? How will Nigeria get the much needed 100,000 or more megawatts needed for development?

Niminho: I think coal is not the only option. Neither is gas the only option. We have other options: solar, wind and thermal solutions are options that are not burning fossil fuels. I think Nigeria is very slow in exploiting sustainable options. Also, every coal mine has a life span – they are exhaustible, so coal is a short term source of energy but we need to have energy in the long term from something that is safer for the environment.

hbs: Germany has had a long tradition of using coal, and knows the problematic legacy it leaves behind. Impoverished coal mining areas, environmental devastation, polluted ground waters, sinking cities and toxic pits are long-term legacies that are costly to deal with. How is ETA Zuma going to deal with these predictable consequences of coal mining and power generation?

Ayalogu: Thank you for the question. Germany is a place we’d all love to be, the home of the Mercedes Benz and the good life, so we’ll say “give it to us and when the negative aspect comes, we’ll deal with it”. The point is that Germany needed power and got it and became a world power based on the fact that it was able to become industrialized. When Germany was at the peak of getting power from coal, technology was a little bit backwards, but the situation has changed. There are environmental mitigation processes that are already in place to be effective to make profit. Let’s assume we start construction next year with the first tranche of 300 megawatts. It takes approximately 30 months to complete and roll into action, so we are looking forward to actualizing the 1,200 megawatt limit within the next 5 years or so.

hbs: Are you planning for carbon capture and storage (CCS), which is a relatively new technology that captures the carbon out of the smoke emissions from the coal plant and forces it back into the soil?

Ayalogu: Yes, we will use CCS. Itobe is a modern technologically engaged activity. We are not going to pick up some old used technology from Europe. The intention is that we deploy the best of technologies that is currently available.

hbs: There aren’t many sites in the world where CCS has really been tested and proven to be successful, and where it is in operation in the US and Norway, there is no scientific study to prove that the carbon actually stays underground. What if the carbon starts leaking out of the soil?

Ayalogu: Carbon is always with us.

hbs: But not in that concentration...

Ayalogu: This is why the technology that will be deployed in Itobe will meet the minimum World Bank standards. The issue is that we know we will use CCS. Itobe is a modern technology from Europe. The intention is that we deploy the best of technologies that is currently available.

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The coal industry uses taxpayers’ money to keep its prices low – and it does not compensate for the costs of climate change or disease. A brief look at the scale of the problem.

Supporters often say that coal produces cheap energy. But things are not quite as simple as the industry suggests. The real cost depends on what is included in the reckoning, and who pays for that. The price of power reflects the costs incurred by the energy producer, along with taxes and levies.

However, some factors are not included in the price and never show up on an electricity bill. These are the so-called external costs. These externalities occur when a market actor (in this case, the coal company) affects the welfare of others but does not compensate them. In other words, the person or organization that causes a problem does not pay fully for its consequences. It pulls in a profit but passes part of the costs on to third parties, or to society at large.

Mining and burning coal involve enormous external costs. The most significant costs are government subsidies, environmental damage and harm to human health. Taking this into account, coal becomes an expensive commodity. The International Monetary Fund has revealed that post-tax costs for coal amounted to 3.0 percent of global GDP in 2011, rising to 3.9 percent in 2015. This is largely due to the high environmental costs associated with coal consumption.

Those costs include greenhouse gas emissions and air pollution. It is impossible to put hard numbers on these; instead, we have to rely on estimates and judgement. Some types of damage cannot be reversed. In addition, costs are not based on the intrinsic value of ecosystems harmed by climate change, for example, or on the economic losses. The costs of repairing damage after a major accident are included, but only to a limited extent, to avoid forcing the business concerned into bankruptcy if damages are claimed.

These considerations mean that any figures – such as those provided by the British consulting firm Trucost to the United Nations Environment Programme – are politically tinged. The numbers should be treated with caution, but they are huge, even if they are just the tip of the iceberg. According to Trucost, the external costs of using coal to generate power in 2009 amounted to $452 billion in East Asia alone. These costs were mainly attributed to greenhouse gas emissions and air pollution. In the same year, the costs in North America reached $316 billion.

In Germany, air pollution and greenhouse gases added up to more than 28 billion euros – exceeding what was spent to support renewable energy. For lignite, the German Federal Environment Agency puts the environmental costs at around 11 euro cents per kilowatt-hour; for hard coal, the figure is 9 cents. If these costs were reflected in the energy price, electricity bills would rise. In the USA, researchers estimate that a coal-fired kilowatt-hour would have to cost between 9 and 27 US cents more than the customary 10 cents appearing on the electricity bill. If the coal companies were to internalize these external costs, coal would barely be competitive and would be displaced from the market as a result.

A more realistic price would not automatically compensate people harmed by climate change or those suffering from air pollution. The coal companies should have to take on the legal as well as the financial responsibility. A public admission of guilt and an apology to the victims would be appropriate. Both are taboo for the industry.

The apparent cheapness of coal is also a result of subsidies from the taxpayer, both current and in the past. Energy producers are still profiting from the support they received in the past. In 2014, the German consulting firm Ecoinet put together some impressive figures for the European Commission. Between 1990 and 2007, the current 28 members of the European Union subsidized the expansion of coal-related infrastructure to the tune of 200 billion euros. Only nuclear power got more support, with 220 billion euros. Aside from 100 billion euros spent on hydropower, renewables were not directly subsidized.

Government support has ensured that locally produced coal stays competitive. Between 1970 and 2007 this support cost the EU countries a total of 340 billion euros. Germany leads in the subsidy race. One source of funding is the 1.2 billion euros that the German government contributes directly to the hard-coal mining industry.

Between 1974 and 2007, the EU governments as a whole spent around 87 billion euros on fuel research and development. Nuclear power got the biggest chunk, at 78 percent. Another 12 percent went to renewables, and 10 percent to fossil fuels – with coal getting more than oil and gas. In 2012, the member states of the EU handed out a total of 13.4 billion euros to the fossil-fuel industry. Outside the EU, coal subsidies are huge, too. A study by the Global Subsidies Initiative found that in Turkey, for example, they amounted to $730 million. The OECD puts the figure for Australia at over $125 million in 2011.

In 2009, the governments of the G20 group of major economies committed themselves to phase out subsidies for fossil fuels in the medium term. The worldwide shift to renewable energy will gather pace if they put their promises into action.

Subsidies make sense if they improve the energy mix. But coal is part of the problem, not part of the solution.
Successful climate policies mean that coal is becoming a less valuable resource. This affects the companies that dig it up.

In 2009, a team of researchers at the Potsdam Institute for Climate Impact Research published a groundbreaking study calculating the size of the global carbon budget. That is the amount of CO_2_ that can be emitted if the rise in the Earth’s surface temperature is to be held below 2 degrees Celsius. A key finding: if we continue pumping out as much greenhouse gas into the atmosphere as we have so far, we will have used up the budget in just 14 years — and the temperature will rise more than 2°C. In addition, it means that the carbon budget sets a limit to the amount of coal, oil and gas we can burn. All the fossil energy sources beyond this limit are “unburnable carbon” — a phrase coined by the Carbon Tracker Initiative that has become an important measure in global climate policymaking. The Carbon Tracker Initiative calculates that 2,795 gigatonnes of CO_2_ are stored in oil, gas and coal reserves in private and government hands and listed on stock exchanges. Compare that to the global carbon budget of 565 gigatonnes. In a nutshell: four-fifths of the reserves are “unburnable carbon”.

Two scientists at University College London have worked out what these calculations imply for the use of individual fossil fuels in different locations. They published their findings in the journal Nature at the beginning of 2015: to keep within the 2°C limit, we can burn only about 12 percent of current global coal reserves, two thirds of the oil and about 50 percent of the natural gas reserves. The restrictions would be even tighter if we are to keep within a 1.5°C rise, as recommended by climate science.

Policy decisions and lower market prices for energy, partly as a result of advances in renewable energy, could leave most fossil-fuel investments as “stranded assets”. Against investors’ expectations, such assets would bring in no profit; on the contrary, they would have to be written off as more or less worthless. The Carbon Tracker Initiative calls this investment problem the “carbon bubble”, named after the speculative peaks in the world of finance, such as the property bubble that sparked the economic crisis in 2008. The phenomenon is not restricted to coal: oil and gas reserves are also affected.

Despite this, private and government financial institutions continue to invest in the companies affected; or to grant credit on the basis of the previous policy situation. Fossil-fuel reserves are included in the trading value of companies: the production licenses of mining companies, the generation capacity of power producers, and the investments by banks in these firms. If the bubble bursts, these companies will see their value crash.

A global financial crisis. The big coal producers at least partly on the contrary, they should have to be written off as more or less worthless. The Carbon Tracker Initiative calls this investment problem the “carbon bubble”, named after the speculative peaks in the world of finance, such as the property bubble that sparked the economic crisis in 2008. The phenomenon is not restricted to coal: oil and gas reserves are also affected.

Despite this, private and government financial institutions continue to invest in the companies affected; or to grant credit on the basis of the previous policy situation. Fossil-fuel reserves are included in the trading value of companies: the production licenses of mining companies, the generation capacity of power producers, and the investments by banks in these firms. If the bubble bursts, these companies will see their value crash.

A stock market crash in 2008 strikingly demonstrated how fast coal prices can fall. In 2011, they were still high, at over 100 euros per tonne. But in August 2015, they stood at just 20 euros. The price of coal in China fell by 50% over the same period. This means that even Asian firms are losing money on coal. The end of coal exploitation does not have to trigger a stock market crisis: if investors change course, the world prices affect the Chinese market too, bringing losses to coal producers there. In mid-December 2014, Glencore, a mining giant, shut its 20 mines in Australia for three weeks and told 8,000 workers to take their annual leave — a sign of the depth of problems faced by the industry. Investors should perhaps regard some coal producers themselves as “stranded assets”. Political moves to reduce carbon emissions and develop alternative technologies send the right signals to chief financial officers. More important still, companies in the fossil-fuel sector are also getting a clear message: they should not waste any more money looking for new reserves.
CARBON CAPTURE AND STORAGE

PROBLEMS AT DEPTH

With the promise of ‘clean coal’, the industry intends to store carbon dioxide underground. However, this method of dealing with the climate crisis fails for both technical and economic reasons.

In recent years, political and economic circles have discussed a particular way of making coal-fired power stations more climate friendly. This method is known as ‘carbon capture and storage’. The technique involves capturing the carbon-dioxide emissions from power plants and factories, and storing them in geological formations deep underground. Some scientists and environmentalists hope that this will decelerate the rise of carbon dioxide in the atmosphere, or perhaps even reduce it. Many of the scenarios prepared by the Intergovernmental Panel on Climate Change assume that if carbon capture and storage is used the probable warming level will stay below 2°C. But such assumptions carry a critical flaw. It is already evident that the technologies currently under development cannot achieve what they promise.

It is now possible to capture only 85 to 90 percent of the CO₂ from power stations. Doing so takes energy, which has to come from the power plant itself. The plant, therefore, works 11 to 15 percent less efficiently, cutting its operating costs 11 to 15 percent less efficiently, cutting its operating costs 35 to 30 percent — back to levels common in the 1980s. The plant would have to burn up as much as one-third more coal to produce the same amount of energy. The commercial use of carbon capture and storage would require digging up yet more coal — with all the accompanying negative environmental consequences.

Where could the captured CO₂ be stored? One possibility is in depleted oil and gas fields. In the United States and Norway injecting CO₂ into oilfields is a common procedure to boost the yield of oil. A much bigger but more controversial potential store is in saline aquifers: porous rock formations filled with saline water that are capped by impermeable layers of rock.

The Norwegian energy firm Statoil launched one such storage-and-capture project in 1996 at the Sleipner gas field under the North Sea. Because the natural gas extracted from this field contains too much CO₂, Statoil separates almost a million tonnes of the gas each year, and injects it into rock formations above the gas field to reduce its carbon tax bill. But it is uncertain whether the storage locations will stay sealed over the long term, whether gas can leak out, or whether the seals on the boreholes will corrode. A sudden release of a lot of CO₂ would endanger humans and other living creatures. The saline water displaced by the CO₂ might be forced up into shallower rock layers and contaminate groundwater with salt and toxic substances. The risks are high enough that if the CO₂ is injected into rock formations below the seabed, as planned in countries including Australia and Britain, this type of offshore storage can severely damage the marine environment through leaks of CO₂ and contaminated saline water.

No technique yet exists to monitor CO₂ storage sites, systematically identify leaks or plug them when they are found. A flagship project at In Salah in Algeria was shut down in 2011 because of concerns about storage safety. At present, as a result of technical difficulties and the high cost, which would amount to several billion euros for a big power plant, no plant anywhere in the world separates significant amounts of CO₂ for storage. A small power station in Canada is the only project that gets support from the public purse to boost production from an oilfield. A major project in the United States to demonstrate carbon capture and storage, called FutureGen, would have cost over $1.6 billion. It was suspended in 2015.

Technically, there are several ways of capturing carbon. One is to use chemicals to “wash” CO₂ out of the stream of exhaust gases after combustion. A second approach relies on the principle of coal gasification; it extracts the CO₂ before combustion takes place. A third method involves burning coal using pure oxygen, making it easier to extract the CO₂ from the exhaust. From a technical point of view, carbon capture is better suited to the steel and cement industries because they are less able to avoid producing CO₂.

Despite all the failures, the promise of ‘clean coal’ is still used as a justification for building new coal-fired power plants and thus extending the life of the fossil-fuel business model and decelerating the transition to renewable energy. Carbon-capture plants are less flexible than traditional coal-fired plants in responding to fluctuations in demand for power.

Some coal-fired plants, such as the Drax station in Britain, are able to burn wood as well as coal. In theory, such power stations are supposed to achieve negative carbon emissions by combining carbon capture and storage with the use of bioenergy. Trees absorb CO₂ as they grow. When they are burned, the resulting CO₂ can be pulled out of the cycle if it is captured and stored. A nice idea – but experts say the sums do not add up. Monoculture plantations of fast-growing trees merely displace intact forests, and store a lot less CO₂ than trees.

In addition, it is questionable whether the trees absorb as much CO₂ as is released by fertilizer applications, wood processing, transport and the destruction of intact soils. Using bioenergy would further raise the pressure on arable land as investors acquire large areas to plant biomass. Critics call attention to the connection between this “land grabbing” and the violation of traditional land-use rights of local people who lose their means of subsistence.

At Drax, however, an ambitious carbon-capture project hit an obstacle when the plant owner halted its investment. A cut in subsidies for renewable energy caused a sharp decline in the company’s share price. The other partners in the consortium say the project will continue; a feasibility study will be completed in 2016.
The share of renewable energy in the global power mix is growing fast. Nations and corporations are switching over. However, a complete shift away from fossil energy is not still in sight.

The structure of energy supplies is changing rapidly, but in different ways in different places. On the one hand, the share of renewable energy in power generation is climbing constantly. On the other hand, new coal-fired power plants are still being built. European power generators face a tricky period. Many countries have excess capacity in conventional forms of power; these have to compete with renewables.

In 2014, Denmark and Germany consumed the same amount of energy as in the 1970s. They have managed to decouple their energy use from economic growth. Invest¬ments in ageing power plants and stricter standards for air pollution are pushing the generators’ costs upwards.

Even new plants like the coal-fired power station in Hamburg-Moorburg, which was put online by its operator Vattenfall in 2015, are scarcely economic today. The expansion of renewables in Germany has significantly exceeded most predictions. Many scenarios drawn up in the early 2000s predicted a share for 2020 that was attained by 2010. Meanwhile, they carry on with the old renewables such as photovoltaic, wind, geothermal, wave and biogas are gathering steam. In global rankings, large countries such as Germany, China and the United States are normally at the forefront. But relative to their economic capacity, Uruguay, Mauritius and Costa Rica are investing significantly more in renewables than their larger counterparts. The fact that energy guzzlers in the information technology sector like Facebook and Google are switching to renewables should be a signal to other sectors too. Greenpeace praises Apple because it already gets all the energy it needs from renewables. Data centres worldwide consume more than 30 gigawatts of power – the amount generated by 30 large nuclear plants.

This new reality necessitates a redesign of electricity grids, because the locations where the power is now being generated have moved. To cater for variations in wind and solar power, more flexibility is needed from conventional power plants and from consumers, as well as more storage capacity.

But Germany is just one example: renewables are advancing throughout the world. Half comes from “old” renewables such as hydropower or wood burning. But the “new”
More than 10% of global electricity is produced from renewable energies, and the trend is rising. The UN programme on Sustainable Energy for All thinks that the percentage can rise to 45% of global energy production in the year 2030. The rise of clean energy will bring a sharp fall in demand for coal power, which is already slowing down as some of America’s biggest banks are divesting from coal. Nigeria might soon be offered ‘tokunbo’ coal power plants for importation, as industrialised nations are phasing out coal.

The rise of renewables goes hand-in-hand with the trend towards decentralized power generation. A growing number of power plants operate independently of the national grid, providing clean energy to citizens. Their size can range from large-scale megawatt grids to small-scale options of just a few kilowatts for a single household or business. Nigeria might soon be offered ‘tokunbo’ coal power plants for importation, as industrialised nations are phasing out coal.

The prevalent perception about renewables in Nigeria is that renewable energy systems and technology do not work. The loss of confidence in renewables as viable alternatives for electricity generation stems from bad experiences with imported sub-standard products and poorly executed projects. One example of poor execution is the Lagos State sponsored off-grid solar PV system in Bishop Kodia, which was meant to provide power for lighting, water pumps and fish driers in the fishing village. The system worked for three months and then stopped functioning, according to the traditional ruler. Poorly executed solar street lighting projects in Lagos, Sokoto, Borno, Nassarawa, Delta and Abuja that failed short-term after installation have served to deter further investments in renewables.

In most instances, these bad experiences are caused by lack of maintenance, pilfering, poor quality imported products and components, poor design and installation. Technical expertise within the renewable energy space is few and far between, making it difficult to access quality services. Component retailers and contractors with little or no knowledge about the design and engineering behind providing renewable energy solutions end up executing failed projects.

Renewables are successful in Nigeria

These negative experiences have overshadowed some significant successes in off-grid and grid connected renewable energy projects by professionals. Private sector developers are turning to renewables for captive power generation as Nigeria’s real estate, building and construction sectors experience strong growth. It is no wonder that Suleiman Yusuf, CEO Blue Camel, decided to incorporate rooftop solar hybrid systems on his block of serviced apartments in the heart of Nigeria’s capital city, Abuja.

The cost of the 40kW hybrid solar PV-wind system will be amortized over the next ten years as service charges, which tenants are already used to paying in serviced apartments. Indirectly, Mr. Yusuf is saving the Abuja Distribution Company 40kW of power, which his apartments are not taking from the grid. Imagine the possibilities if new buildings in urban areas were obliged to self generate using rooftop solar hybrid systems.

In underserved rural communities where extending the grid does not make economic sense, renewable energy technologies are becoming the main source of power supply. Green Village Electricity (GVE) installed a 24kWp solar PV system in Egbeke community, Rivers State in 2013. According to the CEO, Ifeanyi Orajaka, the solar PV mini-grid created 36 jobs within the community during the course of implementation. These included artisans like welders who fabricated the PV array structure, electricians who did the cabling, technicians and engineers who installed the panels and system components. The mini-grid provides electricity for 1,920 people living in 240 households, the community church, health center, school and market. In September 2015, GVE commissioned a 24kW solar PV mini-grid installation in Bisanji, Niger State. The system currently serves 1,600 people living in 200 households.

Key to achieving success was that most of the projects highlighted were designed and managed by experienced private sector developers who are service and sustainability oriented. As such, there was no compromising on quality products and components, standard operations and main-
tenance measures, and all parties recognised the need to build lasting relationships with suppliers and end users.

Renewable energy resources—solar PV, concentrated solar power (CSP), wind and non-fossil biomass hold promising potentials for Nigeria’s power generation. Taking into account all the suitable areas that can be used to generate power, Nigeria can get 32,456 terrawatt hours per year from solar PV, plus 10,045 terrawatt hours per year from concentrated solar, and another 12,867 terrawatt hours per year from wind energy.

Forget the grid, here comes solar

Small-scale solar PV rooftop or ground-mounted systems can provide backup power supply as stand alone solutions for individual households and small businesses with predictable energy consumption patterns such as schools, health centers, provision stores, barbershops, tailors, restaurants and market stalls. Smallholder farmers, the majority of whom are women, can benefit immensely from solar powered solutions for function specific uses such as irrigation and food processing. Farming yields and incomes can increase significantly with access to solar water pumps with a drip irrigation system, solar powered grinding machines and solar food dryers.

On a micro-level, quality solar lanterns can substitute for kerosene lanterns used in over 15 million off-grid households. These can reduce the effects and mortality from indoor air pollution.

Undoubtedly, Nigeria needs to increase its power generation capacity by strengthening its base load with conventional power systems from plants that can generate steady flow of electricity into the grid, independent of variables such as sunshine hours, periods of wind slackness or availability of biomass. Base load electricity can be boosted from thermal gas plants rather than coal plants. Gas is much cleaner than coal and more cost effective. Last year, the UK’s electricity generation from coal fell to its lowest level since industrial revolution from 36% in 2013 to 29%. This sharp decrease was attributed to the fall in gas prices compared to coal, making gas more economical to use for electricity generation.

Balancing grid and off-grid options

Whatever feeds the grid, the question remains whether the existing grid infrastructure is robust enough to accommodate substantial power generation increase beyond its current transmission wheeling capacity of 9000MW? And how long will it take to expand the grid? There is no quick fix for the grid. Repairing it will take a long time, expanding its capacity and reach will involve extensions, which require huge investments. The existing grid also lacks the ability to function smartly to accommodate intermittency from renewables.

Despite the intermittency of renewables like wind and solar, these resources are far from being unreliable. Even with conventional power supply, there is a planning process that ensures consistency in electricity supply to meet demand. For renewables, the planning involves balancing sudden fluctuations, having reserve capacity, having a mix of complimentary sources and having spare capacity from a conventional source to smoothen supply. Numerous countries have been able to integrate electricity supply from solar and wind on the strength of modeling and predicting aggregate renewable power available to the grid from existing resource data with reasonable accuracy. It boils down to having a robust grid infrastructure and an enabled operator that can seamlessly integrate conventional and renewable generation to consistently meet demand in an efficient electricity market.

The quick win for Nigeria lies in decentralized renewable power such as Pay-As-You-Go solar. These individual solutions can bring electricity to millions of households, small and medium sized enterprises within months rather than years. This option needs the least investment and regulatory framework—it’s a ready to roll project. And for once, this power would be power in the hands of the people who have been waiting, for too long.

THE POWER OF RENEWABLES

Price crash: As the cost of solar technologies has shrunk by more than 80%, investments into clean energy are now outpacing investments into fossil energy in many markets around the globe.

Pay As You Go Solar could provide millions of small enterprises in Nigeria with reliable and clean electricity within months.

Turning away from coal: 2014 was the first year where China reduced its use of coal by almost 3%. At the same time, the country increased its electricity production by almost 4% from renewable energies.
The decline in consumption did not just happen. The government wants to reduce the use of coal for various reasons. The most important reason is the smog that blankets Chinese cities causing asthma and boosting the risk of cancer. The Chinese people, and especially the emerging middle class, are becoming increasingly irritated. Released in 2015, the documentary “Under the Dome” by journalist Chai Jing, focuses on widespread air pollution, and has attracted attention. Over 150 million Chinese watched this film within just three days. It has since been censored by the authorities.

In the face of widespread dissatisfaction, cities have been switching off their older coal power plants and dozens of provinces have decided to reduce their consumption. A planned national market for CO₂ pollution rights strives to support such efforts. These may make the goal of the “Energy Development Strategy Action Plan”, which aims to reduce the share of coal in the total energy mix to below 62 percent by 2020, down from today’s official 64.2 percent, possible.

The national government is also pushing for the rapid expansion of renewable energy. By 2020, non-fossil energy sources, including nuclear, will account for 15 percent of primary energy consumption; by 2030 their share should rise to at least 20 percent. Meanwhile, no other country is investing as much in hydro, wind and solar power; in 2014, China spent about $90 billion on these power sources. Such investments are not without controversy. Big hydropower projects have been criticized for their negative impacts on the environment and for serious human rights violations. The construction of the Three Gorges dam alone forced the resettlement of almost 1.5 million people. Compared with the previous year, China boosted its installed wind capacity by 26 percent and solar capacity by 67 percent.

That has lead to a decrease in coal production. In 2014, the coal-fired plants produced 1.3 percent less power than in the previous year; on average they are now only running at 54 percent capacity, the lowest level for three decades. China’s coal sector is now suffering from serious overcapacity. That is one reason why several planned coal projects have been halted in recent years.

Falling prices, a ban on especially dirty types of coal, and more stringent environmental requirements have depressed the profits of mining outfits. Three out of four Chinese coal firms have reported losses recently. In the last four years, almost 6,000 coal mines have had to close down. By the end of 2015 another 2,000 mines will padlock their gates. Yet as mining companies are yielding to financial and political pressures, other firms are still planning new coal-fired power plants.

Experts warn of an investment bubble caused by an overcapacity in power generation, because still more new plants are being planned that might go unneeded. The value of companies with extensive coal reserves will undergo a correction on the stock markets as their reserves lose value. That will have knock-on effects on related sectors, on major investors, and on banks that have invested in coal firms or have outstanding loans to them. If the Chinese coal bubble bursts, it will threaten not only the country’s own financial situation but also the rest of Asia. The big Australian and Indonesian coal exporters, which are oriented entirely to the Chinese market, will quickly feel the pain.

The Chinese government has started to treat coal critically and is ushering in an era of renewable energy. That is a strong signal for the rest of the world. Because China stimulates the mass production of modern facilities, their cost will fall. Strange as it may seem, it is the country with the world’s worst pollution that is leading the global energy turnaround.
Coal is an important part of India’s energy mix, and consumption is rising quickly as the economy expands. Local production is not enough: strong demand is attracting imports from Australia and elsewhere. However, India has huge potential for additional power, especially solar and windpower.

One-third, while the proportion of the population living below the poverty line fell by about 16 percent from 1993 to 2011. This means that many of the country’s coal-fired power plants perform very poorly. Even the best did not achieve more than “average” ratings.

Social and environmental costs. And yet each Indian consumes the equivalent of only 0.47 tonnes of oil a year: less than a third of the world average.

Energy poverty – the lack of modern, non-polluting forms of power – harms lives in numerous ways. Daily power shut- downs, known as “load shedding”, increase business costs, reduce efficiency and stop farmers from pumping irrigation water. Burning firewood, cow dung and kerosene pollutes the air indoors and causes respiratory problems, especially among women who do the cooking. Poor lighting means schoolchildren cannot do their homework in the evenings.

India has been able to reduce poverty alongside a massive expansion of coal use over the last two decades. Power production and the amount of coal consumed to produce it nearly quadrupled between 1990 and 2013. The percentage of the population living below the poverty line fell by about one-third, while the proportion of the population with access to electricity fell by half to more than three-quarters.

Coal has alleviated India’s energy access problem and contributed to poverty reduction – though at substantial health, social and environmental costs. And yet each Indian consumes the equivalent of only 0.47 tonnes of oil a year: less than a third of the world average. Energy poverty – the lack of modern, non-polluting forms of power – harms lives in numerous ways. Daily power shut- downs, known as “load shedding”, increase business costs, reduce efficiency and stop farmers from pumping irrigation water. Burning firewood, cow dung and kerosene pollutes the air indoors and causes respiratory problems, especially among women who do the cooking. Poor lighting means schoolchildren cannot do their homework in the evenings.

Major steps in the last three centuries

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Germany has declared an “energy turnaround”, but is still heavily dependent on coal. Lignite is the only significant fossil fuel that the country has and does not have to import. The reserves are estimated at 40 billion tonnes, and are split among three major regions: the Rhine-land, Lusatia and central Germany. In 2014, more than one-quarter of the electricity produced came from lignite, and its output of 178 million tonnes a year makes Germany the world’s biggest producer. The industry has benefited from 95 billion euros in subsidies (in real terms) since 1970, and open-cast mines have gobbled up 176,000 hectares of land. Current mines cover 60,000 hectares.

The mine sites are rehabilitated and brought back into cultivation after mining ends, but the original ecosystem never fully recovers. In many cases, the pits are flooded to form lakes. In the Rhineland that means diverting river wa-ter into the pits for decades on end. The negative environmental impacts of mining include damaged ecosystem, degraded soil, acidified water, water contaminated with sulphates and sludge containing iron, as well as disturbed groundwater regimes. In Lusatia, sulphate from nearby open-cast pits threatens the water quality in the River Spree and, therefore, Berlin’s drinking water supplies.

The federal states that host lignite reserves plan to continue mining well into the 2040s. Vattenfall, the state-owned Swedish power generator, plans to develop five mines in Lusatia in eastern Germany. Two of these were recently approved. The excavators will demolish ancient Sorbian vil-lages, even though this minority group is protected by the constitutions of both the federal states of Brandenburg and Saxony. In North Rhine-Westphalia, in western Germany, the state government decided to reduce the size of Garzweil-er II, an extension of an existing pit.

If Germany intends to stick to its target of cutting its greenhouse gas emissions by 80 to 95 percent by 2050, two-thirds of the lignite reserves already approved for mining will have to stay in the ground. In contrast, Germany’s ex-traction of hard coal will end in 2018. The three pits still in operation produced 7.6 million tonnes of coal in 2014. Ger-many still gets about 18 percent of its power from hard coal. Despite repeated public criticism regarding the human rights situation and environmental effects of coal mining in many coal-exporting countries, Germany imported more than 56 million tonnes in 2014, of which 42 million tonnes were destined for power stations. Most of this coal comes from Russia, followed by the United States, Colombia and Australia.

Germany’s remaining hard-coal mines are closing down because government subsidies are due to end in 2018. With-out these government funds, the mines would have been un-profitable since the middle of the 20th century. Since 1970, the mining companies have benefited from subsidies to the tune of €327 billion in real terms. One of the so-called “inher-ited liabilities” of hard-coal mining is the need to pump out mine water to protect groundwater. From 2019 onwards, dealing with this and other liabilities will cost at least €220 million a year, indefinitely. The money is supposed to come from an endowment fund set up by the industry, but this will probably not be sufficient to cover the costs.

Unlike hard coal, the inherited liabilities of lignite are not recognized politically, and the perpetrators have not had to make adequate financial arrangements. Further-more, the public cannot access the financial presumptions and models that the mining companies use to make plans for reserves to cover damage caused by mining.

Renewables account for around 26 percent of Germany’s energy mix. That is slightly more than lignite, but lignite and hard coal together make up 44 percent. Fixed feed-in tariffs (long-term contracts for energy producers) have spurred the expansion of renewable power and made compensation for the loss of generating capacity possible after Germany de-cided to turn off its nuclear power plants.

Germany is likely to miss its climate goal of 2020 (a 40 percent reduction in greenhouse gas emissions compared to 1990), mainly because of the increase in burning coal. In addition to those measures that have already been decided, supplementary measures are needed to achieve further nec-essary reductions in the power sector.

In early 2015, the government proposed to limit emis-sions from coal-fired power plants with a so-called “cli-mate levy” on old, emissions-intensive power plants. This plan was supported by environmentalists. The public debate over these proposals has been very lively, and there has been strong and effective resistance from coal companies, trade unions and the governments in the three affected states.

The failure of the climate levy and its replacement by a capacity reserve for old coal plants demonstrates the strength of the coal lobby. Unfortunately, the replacement will not be enough to attain the climate goals. Many local governments own shares in the energy group RWE, and they fear a loss of income, which is a major obstacle to the switch away from coal. Nevertheless, the general public’s opinion has turned against coal, and opposition is rising. In fact, accelerating a coal phase-out is the top priority for German National Socialists.

From a peak in the 1980s, RWE’s greenhouse-gas emissions have declined only slightly. RWE is Germany’s second-biggest electricity generator.
Trading in pollution permits has blossomed into a big business. The system has produced little benefit for the climate. Even so, the alternatives are barely discussed.

Trading in pollution permits has blossomed into a big business. The system has produced little benefit for the climate. Even so, the alternatives are barely discussed.

To limit the amount of greenhouse gas they churn out, the European Union and various other countries have set up emission-trading schemes. Based on national plans these schemes set the total amount of emissions permitted for the affected industries. The operators of these industries can trade permits among themselves. If an operator emits less of the offending gas than allowed, it can sell the permits that it does not need. An operator that emits more gas has to buy additional permits. This system is supposed to provide a financial incentive for reducing emissions. A company that discharges too much gas has to pay more, while one that cuts its emissions can sell permits to pay for the investments needed.

Seventeen such schemes have been set up around the world, and several more are planned. The biggest is the European Emission Trading Scheme. National schemes exist in Switzerland, New Zealand and South Korea; California, the Canadian province of Quebec, Tokyo and several provinces in China have regional schemes. By 2016, some 6.8 billion tonnes of CO₂ equivalent will be covered by such measures.

Emissions trading is based on two premises. First, that it limits the emissions of climate-killing CO₂. Second, the scheme aims to stimulate investments in protecting the climate. Sadly, it does neither, as can be seen from how the European scheme has performed.

Under heavy lobbying pressure, the EU set the permitted limits for emissions far too generously, and subsequently cut them back too slowly. From the start, the number of permits has been too high, so the prices they have attracted have been too low to stimulate investment in climate protection. In addition, governments have given away permits for free to the most climate-damaging firms, handing them a big financial windfall.

The recipients, including large power generators, took advantage of the situation and sold their excess certificates. Between 2008 and 2012, the ten major beneficiaries profited by 3.2 billion euros. The energy companies must now bid for the permits they want, but lavish exemptions mean that nearly all polluters in the industry still get them for free. Plus, all companies continue to benefit from the transfer of their surplus permits from earlier trading periods. The steel firm ArcelorMittal, for example, will not have to buy any extra permits before 2024.

In theory, emissions trading is capable of reducing CO₂ emissions while still allowing entrepreneurial freedom. In practice, however, the trading scheme has not made a significant contribution to climate protection. This is because of the so-called offset credits that companies have been able to buy in large numbers outside the emissions trading scheme. The reasoning goes like this: it does not matter where in the world the CO₂ emissions are cut, so rather than investing lots of money in reducing their own emissions, European companies may as well contribute to initiatives that save emissions elsewhere. But how would the initiatives have performed without this financial support? Between one-third and one-half of such projects result in no additional benefit because the investments would have been made anyway. Further, these offsets reduce the pressure in Europe to switch to products that produce fewer emissions.

Emissions trading has long become a business opportunity for the financial industry. Simple, direct transactions between buyers and sellers of pollution permits have become rare. For institutional investors, carbon dioxide is now something akin to a raw material, and is traded in the form of various financial products. But because of the oversupply of permits, trade is virtually at a standstill. Scandals involving tax fraud, including those involving the Deutsche Bank, have revealed the vulnerability and vulnerability of the system. HM Revenue & Customs, the British tax authority, believes that a large share of emissions trading is laced with fraud.

Through offsets, over-supply, the economic crisis of 2008/9 and the associated erroneous forecasts, the number of excess permits in Europe has risen to over two billion. As a result, the price of CO₂ is far too low. Combined with low prices for coal and high prices for natural gas, coal has boomed. Between 2010 and 2013, emissions from this sector rose by six percent. The CO₂ surcharge was not high enough to make power generated from less-harmful natural gas competitive with the more-harmful coal. To achieve the desired effect, the trading scheme needs stricter limits on emissions.

An alternative approach, used by several states in the United States, as well as by Canada and Britain, is to impose CO₂ standards on power plants that use fossil fuel. Since 2013, the British government has set a minimum price for CO₂ and annual emission budgets for new power plants, equivalent to the emissions from a modern gas-fired plant. Since 2014, France has charged a tax – albeit a small one – on fuels. The rate will quadruple until 2020. It is also possible to force old power plants offline by applying a technical criterion to their efficiency. The Netherlands will bring in a minimum requirement that will ensure that four older plants will shut down by 2017.

Explicit criticism of emissions trading as the “wrong solution” came recently from an unexpected quarter. Pope Francis wrote in his encyclical “Laudato si” that emissions trading gives rise to a new type of speculation, but does not serve the cause of cutting greenhouse gases.
LOBBYING
PAID TO PREVENT PROGRESS

Wherever climate and energy negotiations take place, the coal industry wants to have their say. They often succeed.

Ever since climate change and the role of fossil fuels in it became a hot topic, the coal industry has intervened in the debate and has changed its political and economic weight to tip the scales. In the 1990s, global industry came together to combat research on climate change. The biggest private coal firms, collectively known as Big Coal, have been hindered by the climate change policies of the host government’s delegates were representatives of many of the biggest coal companies are state-owned – for example in Poland, the Czech Republic, India and China – has helped break the progress of reform.

The coal sector often has a seat at the table when political decisions are made. In 2007, when Chancellor Angela Merkel took over the EU presidency and hosted a G8 summit on the Baltic coast, the German government had previously appointed the Swede Lars Gőran Josefsson as one of two climate-protection advisors. At the time, Mr Josefsson was the boss of Vattenfall, the largest energy company in the European Union. Vattenfall is one of the energy companies in eastern Germany. He later became an advisor to the UN Secretary-General Ban Ki-moon.

At a climate summit in Durban, South Africa, in 2011, two of the host government’s delegates were representatives of local companies. One came from Eskom, Africa’s largest power producer, and one of the biggest CO₂ emitters in the world. The other was from Sasol, the world’s biggest producer of synthetic petrol, a fuel produced by liquefying coal.

Over the years, critical voices such as the Corporate Europe Observatory have watched as companies try to influence international climate negotiations. The energy companies’ tactics range from sponsoring conferences to the formulation of draft agreements. The oil and gas majors are more active than the coal industry in international climate discussions. The coal industry prefers to shape national discourse and legislation because its activities are more strongly affected by policies at this level.

In the EU, the coal lobby has mainly targeted renewable energy. It argues that it is not necessary to fix what proportion renewable energy makes up of the overall energy mix; emissions trading will be enough to determine this. One of the loudest voices in this debate has been Euracoal, the European Association for Coal and Lignite. Lo and behold, the EU’s climate targets for 2030 no longer include binding national targets for the expansion of renewable power or for improving energy efficiency.

European planned limits for air pollution have also been subject to influence from the coal lobby. The methods are simple: some of the specialists named by member states to the crucial technical working groups are direct representatives of the industry’s interests. The makeup of the Greek delegation was particularly biased. All the delegates worked either for the Public Power Corporation, whose power plants are among the dirtiest in Europe, or for Hellenic Petroleum.

The coal industry enjoys close contacts with governments around the world and tries to influence the direction of international negotiations.

The United States traditionally has a powerful coal lobby. A core element of all its campaigns has been to discredit scientific studies. Since the 1990s, coal companies and industry associations have financed scientists who dispute the findings on global warming and, with success. In 2014, only eight Republicans in the US Congress recognized global warming as scientifically proven; 278 denied it. This reflects the spending patterns of the coal industry which donated $57.5 million to American politicians, 84 percent of them Republicans, between 1990 and 2014.

The American Coalition for Clean Coal Electricity is one of the more important associations of coal lobbyists in the USA. It campaigns against regulations in the coal sector and climate protection. The conservative American Legislative Exchange Council is composed of state legislators and financed partly by money from the energy sector, including Big Coal. In 2013/14, it was active in at least 16 states working against renewable energy.

The lobbyists have everything covered: from the drafting of regulations and rules for the supply of privately generated solar power into the grid, to combating the Environmental Protection Agency and President Obama’s climate policies. Even schools are included. The Kentucky Coal and Energy Education Project distributes educational materials that are biased against climate science. Sowing the doubts has borne fruit; the 2020 target for expanding renewable energy was reduced from 41,000 to 33,000 gigawatt-hours.

In 2014, Australia invested less money in generating clean electricity than Honduras or Myanmar. A new government directive is even expected to halt Australia’s ‘green bank’, the Clean Energy Finance Corporation, from investing in wind and rooftop solar power because the federal government does not regard them as emerging technologies.

Abbott called on Dick Warburton, a noted climate-change sceptic, to review the target. The industry ran big advertising campaigns that were supported by media owned by Rupert Murdoch, whose reports repeatedly questioned the efficiency of renewable energy and the findings of climate science. Sowing the doubts has borne fruit; the 2020 target for expanding renewable energy was reduced from 41,000 to 33,000 gigawatt-hours.

A booming business: the climate debate is generating lots of business for coal industry representatives in Washington.
A BROAD ALLIANCE WITH STAYING POWER

Around the world, people are fighting back against the coal industry. They face repression, harassment and violence – but sometimes they are successful.

International environmental organizations have been protesting for 30 years against the exploitation of nature and the mining of coal. At the grassroots level, local communities are fighting back, too. The Wayuu community in Tamaquito is struggling against Cerrejón, a huge open-cast lignite mine. Locals have mounted a health campaign against two urban coal-fired power plants in Chicago. In Shenzhen, China, the city council rebelled against a 2,000 megawatt plant.

The most visible protests can be found in the developing world, where the use of coal is rising quickly. All around the world, people are taking to the streets: in Australia, Bangladesh, China, Croatia, Finland, France, Germany, India, Malaysia, Mozambique, the Philippines, Sri Lanka and South Africa. Farmers in Inner Mongolia, China’s biggest coal region, have risked their lives by blocking coal transports. In the big cities, people demonstrate against the smog.

Communities affected by coal in Mozambique have repeatedly protested by blocking the Sena railway line that carries coal to the port of Beira. India’s government is expanding the use of coal more than any other country; a national alliance has responded with hunger strikes and protest marches. The activists have been ordered about, imprisoned and threatened. Despite adverse conditions in Colombia, communities are working together to expose the truth about coal mining. Their actions include holding popular tribunals against mining, visits to sacred sites, and autonomous public hearings.

In Australia, the world’s second biggest coal exporter, an alliance of Aboriginal communities, farmers, churches, doctors and environmentalists wants to halt the construction of new port infrastructure and the expansion of existing ones in Queensland. These facilities are intended to serve new or expanded mines to be sited across the Galilee Basin. The alliance uses a variety of tactics, including strategic legal action, lobbying, divestment campaigns, public education and non-violent direct action. It has secured significant victories. For example, Friends of the Earth Australia helped establish Lock the Gate, a powerful alliance that is active throughout Australia. Also, Market Forces, a campaigning organization, has helped shift millions of dollars in investment away from destructive fossil-fuel projects.

In the United States, environmental organizations have been fighting to phase out coal. Thanks to the efforts of a broad coalition, a total of 200 coal-fired power plants – some 40 percent of the country’s total – have been retired since 2010. Such successes are based on a wide-ranging set of arguments: climate change, health threats and environmental damage. In 2014, mass protests against the discharge of toxic waste from mines into rivers took place in West Virginia and North Carolina. Hundreds of thousands of people had been left without drinking water for weeks.

Friends of the Earth Korea works with local communities who have long fought against the expansion of coal-fired power plants. Plans to expand the Yeongheung plant were cancelled recently as a result of protests against air pollution. In an unusual move, the provincial government backed the local action. In an unusual move, the provincial government backed the local action.

This study revealed high levels of hazardous heavy metals and other toxins on people living near the plant.

In Europe, protesters in countries ranging from Denmark to Italy, Croatia and Turkey have undertaken various actions against new coal power plants. They draw attention to the environmental and social costs, the need to protect the climate, and the goal of making energy supplies renewable. The United Kingdom was one of the first countries where such protests gained visibility. The first “Camp for Climate Action” was set up near the Drax power station in Yorkshire in 2001. In a highly symbolic action, some 600 activists tried to break into the plant to disrupt its operations. In the Thames estuary, Greenpeace activists repeatedly blocked access roads to the highly polluting Kingsnorth coal-fired plant over a period of three years.

When the operator abandoned the site, Greenpeace claimed a major victory. Although the British anti-coal movement lost steam during the economic and financial crisis, the approaches it pioneered live on. Climate camps, with their mix of actions, information and discussions, have spread to Belgium, Germany, the Netherlands, Scandinavia, South Africa, and the United States.

In Germany, campaigns against coal have been held for decades, though they have been only local or regional in scope. Around 2006, however, protests grew louder after investors announced plans for 38 new coal-fired power plants. Climate Alliance Germany was formed in 2007. This broad coalition includes churches and development organisations such as Bread for the World and Oxfam, which added coal to their campaign agendas. The alliance launched an anti-coal movement in 2008. In the following years, environmental groups such as Friends of the Earth Germany and Deutsche Umwelthilfe tried to stop the projects, in part through the courts. They were successful: 22 new plants were stopped and many more delayed. The court orders have been accompanied by public pressure questioning the role of coal in climate and energy policies, and pointing out the plants’ lack of economic viability.

Since 2011, the German lignite mining areas have also seen a range of protests: both local rallies and international actions. In 2014, environmental NGOs organized a human chain stretching several kilometres through Lusatia, with 7,500 people from all over Europe. In 2015, 6,000 people formed another chain in the Rhineland. There, in August of the same year, about 1,500 protesters took part in the largest act of civil disobedience seen in Germany for decades. Under the banner “Ende Gelaende” (Here and no further) they climbed into the Garzweiler mine, forcing it to shut down for nearly a day. The mine’s operator, German coal giant RWE, has taken legal action against 800 demonstrators. Nevertheless, activists consider the event a huge success for the climate movement.

Not all protests against the coal industry are registered in the Environmental Justice Atlas. But many are, revealing major areas of conflict.
The imaginary thoughts of an African investor about to invest in coal, or not. Weighing the desire for profits in the ‘era of the megawatt boom’ against fears of investing in stranded assets as elsewhere, the time of coal seems to end. This is a hypothetical piece. Written by energy analyst Mej Obada.

**Thursday 16 April:** It’s been a while since I kept a record of activities; this should make for interesting reading when the project is up and running.) Had another meeting with the power plant developer and the regulator today. Came away with a long list of requirements - problem is we have to meet up with everything. No cutting corners here oooo!

**Tuesday 28 April:** Still expecting EIA template from inside man at the Ministry. I did not know they insisted on these environmental impact assessments now. I hope he doesn’t fail to deliver. It doesn’t matter if it’s for a limestone quarry in the South-South; we’ll just modify it for our coal project in North State and no one will be the wiser.

**Wednesday 29 April:** Chai! See me see wahala ooo! Some disturbing news! Those environmentalists have picketed the mine site. Their leader (who has refused to see reason; maybe I should increase the offer to 20,000,007) is saying all sorts of things about the future impact of excavation on the land. Why should I care about that? (If no concern me at all). It’s in the future and I’d have recouped my investment and been long gone by then.

**Friday 01 May:** Relaxing in the business class lounge at Schiphol airport en-route to Geneva to meet our investors and bankers. I do hope our press contacts have been able to “kill” the story about the protest; enough money was shelled out for that purpose. We wouldn’t want our Swiss friends worried about the deal at this late stage. Those activists are not good for our country, they oppose rural electrification! Luckily the government committees on these matters are not aware of all the issues raised by the protesters.

**Monday 04 May:** The meeting went quite well under the circumstances. I was able to reassure them that the risks are not as serious, and that our EIA process is flexible. They liked to hear that, one was even smiling saying that the lack of enforcement can be a good thing sometimes.

**Tuesday 05 May:** Europe can make you worry too much. I picked up the papers this morning and read that a farmer is now taking RWE to court for producing carbon emissions. That’s one of Germany’s leading energy companies, the queen of coal! Carbon what? Community what? Our communities at home need the electricity. But what if someone decides to take my company… for carbon’s sake… how can we avoid being taken to court over smoke from some chimneys?

**Wednesday 13 May:** Good story on the project appeared in “Business Times”. Finally the media are picking up on the great advantages of coal, that it’s cheap and so on. Great job, they didn’t mention the health cost and environmental cost that comes with decommissioning coal plants. We’ve got it sorted.

**Saturday 16 May:** Ran into Senator Igg at a wedding ceremony; he was happy that Sonnex Investments’ project is in his zone and has pledged all the support he can provide. He promised his people coal jobs during the campaign. Smart move, it made him win the elections. Coal jobs that will bring more electricity - the coal revolution was a good sell! Obviously, most of the jobs will not go to the locals in his constituency. Not a chance - that would mean a lot of investment into training for them. We didn’t put that in our business plan. Let’s get the best people wherever we find them...

**Friday 29 May:** Listening to the President’s speech on my way to the gubernatorial inauguration; he listed solids mineral mining as one of the areas by which youth unemployment will be tackled. Too early for specifics but very encouraging nonetheless; must be sure to send full text of the speech to Geva.

**Arrived at Gomboro City in time for the ceremony there - got to shake the Governor’s hand and let him know his continued support is appreciated.**

**Thursday 04 June:** Invited to a conference on sustainability - I’m able to sustain so who needs that? Let them keep their conference; some of us have businesses to run.

**Saturday 30 May:** Decided to visit the mining site since I’m here - work here is proceeding quite well. The Australians are worth every US cent they’re charging but I can’t wait to see them leave. Person must make profit from this venture after all. Meanwhile the village head and youth leader have come up with some fresh demands. What did they think they were signing 3 years ago, when we met with some of their chiefs… it wasn’t a blank cheque after all. Sonnex is not a charity.

**Monday 13 July:** Super-excitng - latest reports from the mining crew indicate that we’re likely to exceed our projected output by at least 15% per annum! Based on available information there should be sufficient coal resources to support the mining operation for over 30 years at this rate of production. Where is that bottle of Dom Perignon?

**Tuesday 21 July:** Conference call with the Swiss investors and Australian mining crew; the former are worried that we still don’t have clear policies/ directions on mining… Luckily the 2 local banks providing funding for the venture are not as jittery about this situation; they’re certainly well hedged against risk and their interest rates are through the roof in any case. But still, we need direction from the Ministry. They should come out clear and loud to say that our country is not interested in carbon reductions, but in coal power. That’s how successful businesses grow.

*But what do I do with my plots of land near Gomboro City… they were meant for my children, for their future. Should I buy somewhere else now, in case the place becomes like Beijing where you cannot know night from day with all that coal smoke in the air. This carbon question is starting to vex me…*

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**CONFLICTS**

Even before the violence in the North East spiraled out of control, young populations in northern Nigeria were facing an extremely devastated environment. Water shortages led to farmlands turning into sand dunes and the number of kidney patients was rising as people simply did not have enough drinking water. There is a steady and silent movement of thousands of people southwards, all the way from Lake Chad to Sokoto and Kebbi States, as the land does not feed its people any longer. The southward movement will soon be met by a northward movement of climate refugees from flooded zones in Nigeria’s coastal regions. When all of these internally displaced people converge in Nigeria’s Middle Belt, increasing conflict is the likely scenario, with a wide variety of manifestations such as farmer-herder conflicts, community clashes over access to water, tension between so-called indigenous and so-called settlers, legal action of landlords versus farm workers, and more.
Friends of the Earth International is the world’s largest grassroots environmental network, uniting 75 national member groups and some 5,000 local activist groups on every continent. With over 2 million members and supporters around the world, we campaign on today’s most urgent environmental and social issues. We challenge the current model of economic and corporate globalization, and promote solutions that will help to create environmentally sustainable and socially just societies. Our decentralized and democratic structure allows all member groups to participate in decision-making. We strive for gender equity in all of our campaigns and structures. Our international positions are informed and strengthened by our work with communities, and our alliances with indigenous peoples, farmers’ movements, trade unions, human rights groups and others. We believe that our children’s future will be better because of what we do.

Friends of the Earth International
Nieuwe Looiersstraat 31, 1017 VA Amsterdam, The Netherlands, www.foei.org

Why does Nigeria have to become green? ‘Let’s develop first, we can always go green later’, many people would say, reflecting the fact that more than 100 million Nigerians are living on less than one dollar a day, whilst GDP has been rising by almost 7 per cent year by year. However, such a development approach ignores the fact that NOW is the time to balance the interests of current and future generations; to provide electricity to all 170 million Nigerians whilst maintaining a low carbon profile; to involve women in a new kind of agriculture; to offer millions of unemployed youth a livable future that does not destroy their environment nor the planet. The Heinrich Böll Foundation works with Nigerian partners for green development concepts that should bring more equality and responsible resource management to Nigeria.

Heinrich Böll Foundation Nigeria
93 Awolowo Way, Jabi, Abuja
www.ng.boell.org

HEINRICH BÖLL FOUNDATION
Fostering democracy and upholding human rights, taking action to prevent the destruction of the global ecosystem, advancing equality between women and men, securing peace through conflict prevention in crisis zones, and defending the freedom of individuals against excessive state and economic power – these are the objectives that drive the ideas and actions of the Heinrich Böll Foundation. We maintain close ties to the German Green Party (Alliance 90/The Greens) and as a think tank for green visions and projects, we are part of an international network encompassing well over 300 partner projects in approximately 60 countries.

The Heinrich Böll Foundation works independently and nurtures a spirit of intellectual openness. We maintain a worldwide network with currently 30 international offices.

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Generating electricity from coal damages the climate most. Gas-powered plants emit only half as much CO₂.

from SPOILING THE CLIMATE, page 14

The apparent cheapness of coal is also a result of subsidies from the taxpayer, both current and in the past.

from HIDDEN PAYMENTS, UNPAID BILLS, page 27

No technique yet exists to monitor CO₂ storage sites, systematically identify leaks or plug them when they are found.

from PROBLEMS AT DEPTH, page 46

Divesting from coal now is necessary to prevent disastrous climate change and a global financial crisis.

from DEFLATING THE CARBON BUBBLE, page 30