Tar sands

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Fuelling the climate crisis, undermining EU energy security and damaging development objectives

oil & gas

EXTRACTION	INDIGENOUS COMMUNITIES	GREENHOUSE GASES	
DEVELOPMENT IMPACT	EU POLICY	CLIMATE CHANGE	WATER

extractive industries: blessing or curse?

Tar sands

Fuelling the climate crisis, undermining EU energy security and damaging development objectives

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Executive summary

Conventional oil production is in decline. Unless appropriate policies are adopted to encourage the use of cleaner, non-fossil fuels, investment in dirtier, "unconventional" forms of oil – heavy crude, tar sands and oil shale - will increase to fill the supply gap.

Night view of smoke plumes emitted from the Syncrude upgrader plant north of Fort McMurray.
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Tar sands - bitumen that is extracted and upgraded to produce synthetic crude - has been heavily criticised for its poor environmental and social outcomes, locally and globally. Tar sands generates on average 3 to 5 times more greenhouse gas (GHG) emissions than conventional oil, representing a huge threat to climate protection. Canada is currently the only major centre of production but investment is expanding, including by European oil companies such as BP, Shell, Total and ENI – in the second part of this report we show which oil companies are increasing their investments in tar sands and oil shale, and where. In Canada, tar sands development is the fastest growing source of GHG emissions and is undermining the country's Kyoto commitments.

Tar sands projects are also extremely costly and capital intensive – to the point where investors and analysts have raised concerns about their longer-term financial viability in a world where the introduction of low-carbon regulation and reduced demand for expensive fossil fuels are increasingly likely. A more strategic approach to energy policy would encourage redirection of the hundreds of billions to be invested over the next decade in tar sands production in Canada alone into development of renewable fuel technologies and energy efficiency measures.

The EU is committed to tackling climate change and Europe's dangerous dependency on imported fossil fuels by moving to a low-carbon energy path. A "green" stimulus is also seen as the way out of the current financial crisis and a motor for Europe's future sustainable development. But for its climate and energy goals to be credible, the EU must take effective policy steps to prevent the "re-carbonization" of our economy that will inevitably result from expanding production of tar sands and other forms of unconventional oil. Current levels of tar sands imports into the EU are low but are bound to increase as production and refining capacity expands. Use of such climate-damaging energy products is simply not compatible with the shift to a low-carbon economy. They must therefore be actively stopped from entering the EU market.

Time is critical since, as this briefing outlines, unconventional oil resources are about to go global. New deposits of tar sands and other unconventional oil have been discovered or are already being exploited in countries such as Venezuela, Madagascar, Congo-Brazzaville, Russia, Jordan, Nigeria and Angola. One new frontier for tar sands development is Africa, a region already highly vulnerable to the impacts of climate change. Apart from making a mockery of climate protection, tar sands production in Canada has resulted in serious damage to local communities and the environment, including destruction of the boreal forest and increased pollution that has impacted on the health and livelihoods of First Nations communities. In countries with weaker political and environmental governance frameworks, the consequences of its expansion are likely to be devastating. In Africa, in particular, progress towards Millennium Development Goal 7 on Environmental Sustainability will be seriously under threat. Considering experiences with conventional oil extraction in many African countries over the last decades, tar sands development will also hamper achievement of other MDGs.

Tar sands

If the EU is serious about tackling the interlinked climate and energy challenges faced by European consumers, investors and the private sector - not to mention supporting sustainable development in Africa - it should assume its responsibility as a global standard-setter, sending a clear signal discouraging the deployment of high-carbon technologies like tar sands before they are "locked-in" and start producing for the European market. It can do this, firstly, by not giving political or financial assistance to tar sands development. Secondly, the EU can adopt appropriate import regimes to incentivise cleaner fuel sources, as California has already done through adoption of a low-carbon fuel standard.

As this briefing explains, the EU's 2007 Fuel Quality Directive (FQD), which sets a 10% target for GHG emissions cuts from transport fuel, is an opportunity to move in the right direction. There are significant differences in GHG emissions between different forms of fossil fuel extraction and refining – tar sands being a much higher emitter than most forms of conventional crude – which means there is potential for significant savings.

To realise these potential savings, the FQD must express the different carbon footprints of oil-based fuel products entering the EU, by assigning them a value that represents their – higher or lower - GHG intensity. This will provide an incentive to refiners to source from lower carbon products and for producers to clean up extraction technologies. However, the Commission's current proposal, pushed by oil companies and the Canadian government, is to assign a single value for GHG intensity for all oil-based fuel entering the EU, no matter how polluting its source.

Having only one default value means that there is serious risk that the GHG emissions of higher-carbon fuels will be under-estimated. In its current form, the FQD will open the door to these most environmentally damaging forms of oil and will not achieve its objective. It will encourage the global expansion of tar sands, putting vulnerable communities at risk, and will slow progress towards the EU's wider climate and energy goals.

The EU must therefore urgently address the specific question mark over the methodology for implementing the FQD, as a first step, and subsequently develop a wider policy response to prevent further climate and local environmental and social damage from unconventional oil production. And finally, the EU should also refrain from giving political or financial support to tar sands projects, particularly in developing countries with weak governance framework.

Vehicle pollution.

Tar sands – Fuelling the climate crisis, undermining EU energy security, and damaging development objectives

1

Boreal forest, Albert, Canada

1.1 Introduction

The new *Europe 2020* strategy charts a route towards a "smart, sustainable and inclusive economy" through tackling climate change and fossil fuel dependency. In concrete terms, this means implementation of Europe's "20/20/20" targets on climate and energy: cutting GHG emissions, increasing renewables and improving energy efficiency by 20% by 2020.

Continuing down our current high carbon path is not an option: the current trajectory for GHG emissions from the energy sector could lead to a rise in temperature of up to 6°C with potentially unmanageable social and economic impacts. Relying on expensive imported hydrocarbons is also economically unsustainable: moving to a low-carbon economy would enhance the EU's energy security by cutting import bills, as well as stabilising the climate. Transforming energy production and consumption will also drive economic recovery and green growth post-2020.

However, deeper and faster cuts are required to stabilise GHG emissions at what many now consider the safe level of 350 parts per million. Recent research for FoEE by the Stockholm Environment Institute shows that a *40%* reduction in domestic emissions by 2020 and a *90+%* reduction by 2050 are possible.

The EU should also show real leadership on climate protection by actively discouraging new investment in energy sources that would effectively "re-carbonise" our economy. This includes false "renewables" such as agro-fuels and "unconventional" oil (heavy oil, tar sands and oil shale). With production from existing conventional oil fields predicted to decline, and with no change from our current energy path, "unconventional" oil will increasingly fill the supply gap, providing around 11% of total oil output by 2030. Over half this amount will come from tar sands in Canada.

Tar sands production – the production of synthetic crude from bitumen - has a very high carbon footprint, on average producing *3-5 times* more emissions per barrel than conventional oil. It is the fastest growing source of emissions in Canada, undermining the country's Kyoto commitments, and its further expansion risks tipping the world over the brink in terms of climate damage. If all North America's unconventional oil reserves were fully developed, the total emissions released would be equivalent to 20 years of global emissions at 2004 level.

Tar sands production also poses unquantifiable environmental and social risks to local environments and communities: in Alberta, it has been heavily criticised for causing deforestation and for increasing air and water pollution, with health and livelihood impacts on First Nations communities.

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Oil companies such as Shell claim Carbon Capture and Storage (CCS) and efficiency improvements will reduce future emissions from tar sands production. However, investors and NGOs are concerned that this is not feasible given the untested nature of CCS and the huge costs of using it on a commercial scale. In addition, companies do not appear in their business model to be taking into account the cost of future carbon prices, low-carbon regulation and the probability that high oil prices will lead to a reduction in demand.

For all these reasons, the estimated US$379 billion to be invested in Canadian tar sands in the period to 2025 would be better spent on financing the shift to a low-carbon economy – or on efforts to meet the Millennium Development Goals.

The *2020 Strategy* recognises that European policy makers cannot consider the EU's climate and energy security goals in isolation, but must promote "a worldwide solution to the problems of climate change". This is crucial given that international expansion of tar sands and other unconventional oil resources is already occurring. Investments are underway or planned in Jordan, Russia, Venezuela, Republic of Congo, Madagascar and possibly Nigeria.

Given the environmental and social damage tar sands has caused in Canada, global expansion of unconventional oil - particularly in countries with weaker governance frameworks – would be disastrous for the climate and likely to produce even worse outcomes for the affected communities and their environments. Africa is one important new frontier for unconventional oil exploration and also a privileged development partner for the EU. Support for unconventional oil development in Africa risks undermining the EU's development objectives – particularly Millennium Development Goal 7 on Environmental Sustainability - as well as setting back the global transition to a low-carbon world.

The Africa-EU Energy Partnership (AEEP) recognises the need to enhance energy sustainability in the continent through development of a renewable energy infrastructure, as well as mitigating the climate change impacts that are already affecting the continent. However, this vision jars with the AEEP's emphasis on Africa as an increasingly important marginal supplier of (largely hydrocarbon) energy exports to the EU market. Historically, export-oriented energy projects undertaken by European corporations and agencies in Africa have resulted in extremely poor governance and economic outcomes for African citizens.

It is therefore essential that policymakers adequately assess the implications of future EU energy policy, investment and cooperation with Africa on the development and energy security of local communities and producer states, as well as its long-term benefits for European consumers, investors and the private sector. Unconventional oil development is likely to result in irreversible environmental and social damage, further undermining the governance and energy sustainability of the host countries and their progress towards the MDGs, while not improving the energy security of importing regions.

The EU should therefore send a clear signal to the market discouraging further investment in tar sands and other unconventional oil. The level of tar sands imports into the EU is currently low, but planned expansion of production in Canada and pipeline and refining infrastructure in the US means much greater levels of tar sands imports could soon start to enter the EU – not to mention the effects of worldwide expansion.

Firstly, the EU and its member states should refrain from giving political or financial assistance to tar sands projects, particularly in developing countries with weak governance frameworks. In addition, the EU should introduce appropriate import regimes that incentivise the use of low carbon energy products and emissions reductions, while disincentivizing high carbon emitters such as tar sands. California has already taken a step in this direction by introducing a 10% target for low carbon transport fuels in 2007, while the US Congress in the same year passed a provision banning US federal agencies using oil from tar sands.

Firm EU leadership on climate protection by promoting cleaner forms of fuel is even more crucial given the EU's role as a global standard-setter. Article 7(a) of the FQD includes the target of a 10% reduction in GHG emissions from the transport sector by 2020 (97% of EU transport fuel is still fossil fuel-based). Significant emissions savings can only come from how fuel is produced, refined and distributed ("well-to-tank" emissions), as emissions from combustion are largely the same whatever the fuel source. For fossil fuels, the GHG intensity of different types of extraction and refining varies hugely – as in the case of tar sands production, whose carbon footprint is much higher than conventional oil. Cleaner forms of extraction and refining of fossil fuels thus offer huge potential for reductions.

However, the incentive for this clean-up will only exist if the different carbon footprints of the oil-based fuel products entering the EU are taken into account, by assigning them values that express their - higher or lower - GHG intensities. Currently, the Commission is in danger of missing the historic opportunity the FQD offers by proposing to assign a *single* default value for GHG emissions for *all* transport fuels extracted from oil. Fuel derived from tar sands, for instance, has between 18% and 49% higher emissions than the current EU draft default value for petrol.

Giving all oil-based fuel a single value will not encourage the use of cleaner fuels, nor incentivise improvements in extraction and refining methods for the dirtier forms. It also means that there is a serious risk that the GHG intensity of tar sands entering the EU market will be under-estimated – as will also occur if its value is set too low. If the FQD fails to provide an effective framework for distinguishing the high from low emitters, it will open the door to the most climate-damaging energy products like tar sands and will undermine the EU's claim to be the most "climate-friendly" region in the world.

"Climate and resource challenges require drastic action. Strong dependence on fossil fuels such as oil and inefficient use of raw materials expose our consumers and businesses to harmful and costly price shocks, threatening our economic security and contributing to climate change. The expansion of the world population from 6 to 9 billion will intensify global competition for natural resources, and put pressure on the environment. The EU must continue its outreach to other parts of the world in pursuit of a worldwide solution to the problems of climate change at the same time as we implement our agreed climate and energy strategy across the territory of the Union.

"EUROPE 2020: A strategy for smart, sustainable and inclusive growth[1].

As a result of the bitumen mining process, tailings seep into the surrounding watershed.
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1.2 A resource-efficient Europe?

In March 2010, the new Europe 2020 Strategy laid out the Commission's vision for overcoming Europe's financial and economic crisis and achieving a "smart, sustainable and inclusive economy". The Strategy is premised on "drastic action" to counter the interlinked threats of climate change, growing world population and dwindling natural resources. It recognises that sustainable growth in Europe can only be achieved by "decarbonising our economy, increasing the use of renewable sources, modernising our energy efficiency"[2].

In the same month, the EU reaffirmed its commitment to tackling climate change, specifically by pushing for a global deal on greenhouse gas (GHG) emissions by 2013 and starting roll-out of over €2 billion in financing for mitigation in developing countries. Despite the failure to get a legally-binding agreement on emissions cuts at Copenhagen, both the new EU Commissioner for Climate Change, Connie Hedegaard, and President Barroso emphasised that Europe must "show leadership by taking tangible action to become the most climate-friendly region of the world"[3].

The energy sector currently accounts for around 60% of global carbon emissions - 80 % in the EU[4]. The EU's first step to realising a "resource-efficient Europe", according to the Strategy is implementing the "20/20/20" targets on climate and energy: cutting GHG emissions by at least 20% compared to 1990 levels (rising to a maximum of 30% if other major economies come on board), increasing the share of renewable energy to 20%, and improving energy efficiency by 20% by 2020[5].

It is clear that the age of cheap energy, at least in the short to medium term, is over. According to the International Energy Agency (IEA), tackling climate change by moving to a low-carbon "450 scenario" – where emissions are reduced so that overall GHGs peak at the level of 450 parts per million (ppm) of C02 equivalent – will mean substantial costs[6]. For the EU, this is estimated by the IEA as additional investment equal to 0.3% of GDP in 2020, rising to 0.6% of GDP by 2030[7].

In fact, the latest scientific evidence suggests that stabilisation of greenhouse gases at 450 ppm by 2020 may be too little too late, with many arguing for a lower limit of 350 ppm to be reached as soon as possible[8]. FoEE believes that the EU must set ambitious targets for reducing carbon emissions, and a recent study undertaken by the Stockholm Environment Institute (SEI) for FoEE shows that a 40% reduction by 2020 and a 90+% reduction by 2050 are feasible[9]. The "350 scenario" envisages radically improving energy efficiency and shifting wholesale to renewables: coal would be totally eliminated by 2035 under this scenario, and oil by 2050 in all but a few key sectors[10]. The cost is estimated at approximately 2% of the EU cumulative discounted GDP from 2010-20.

However, even the costs of the deeper, faster cuts envisaged under the "350 scenario" are substantially lower than the bill for inaction. Currently, according to the Intergovernmental Panel on Climate Change (IPCC), on a "high" emissions scenario, the temperature could rise from between 2.4°C to 6.4°C[11], resulting in potentially unmanageable social and economic impacts. The economic costs of "business as usual" have been estimated in the range from 5 to 20% of global GDP annually[12]. As the Commission recognises, such costs will "fall disproportionately on the poorest with the least capacity to adapt, exacerbating the social impacts of climate change"[13].

1.3 Europe's dangerous addiction to fossil fuels

The 2020 Strategy also highlights Europe's current dependence on imported fossil fuels as a major threat to economic security[14]. On current projections, fossil fuels will remain the dominant energy source, accounting for 77% of the increase in demand for the period 2007 to 2030[15].

This "business as usual" or "reference scenario", according to the IEA, sees average prices for oil imports rising in real terms to $100 per bbl by 2020 and $115 per bbl by 2030[16]. In Europe, where imports are predicted to make up 93% of the EU's oil and 84% of its gas supply by 2030[17], the economic and energy security implications of such a continuously rising import bill are clear.

Reducing Europe's structural dependence on increasingly costly fossil fuels is thus essential for our future energy security. As is discussed below, increasing investment in even more expensive marginal sources of conventional oil or developing even more carbon intensive "unconventional" sources, such as tar sands, will only exacerbate the problem.

Moving to a low-carbon economy, on the other hand, would lead to "substantially reduced import bills for most importing countries/regions", as well as the climate, health and environmental benefits of reduced pollution[18]. According to the Europe 2020 Strategy, implementation of the 2020 target for renewable energy would produce a €60 billion saving on Europe's oil and gas imports, while transforming our energy production and consumption patterns will also be a driver of economic recovery and green growth post-2020[19].

Bitumen extraction

Syncrude sulphur waste

1.4 The "unconventional" future of oil: more of the same - and even worse

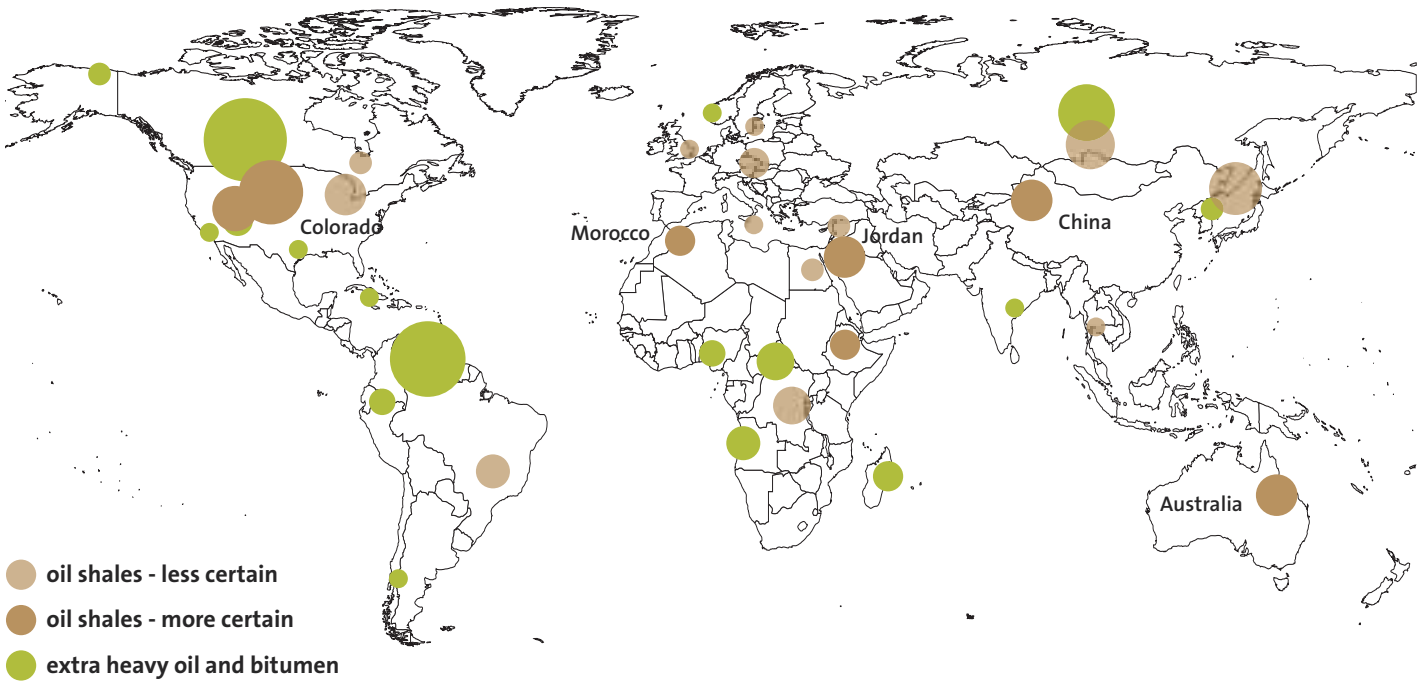
A low-carbon future also entails actively discouraging new investment in energy sources that would effectively "re-carbonise" our economy. This includes false "renewables" such as first-generation agro-fuels, whose production has been encouraged by the setting of EU and member state targets for their use, such as the current 10% target under the Renewable Energy Directive.

"Unconventional" oil is another area of expanding investment that risks tipping the world over the brink in terms of climate damage, while also posing unquantifiable environmental and social risks to local environments and communities. "Unconventional" as opposed to "conventional" oil is heavier or solid forms of crude such as tar sands, extra-heavy oil and oil shale. These resources are found worldwide and are generally more technologically difficult and more costly to extract.

Despite the dampener effect on oil demand in OECD and industrialising countries caused by the current financial and economic crisis[20], under the IEA's "reference" scenario global oil demand is set to increase such that, by 2030, "the equivalent of almost six times the current capacity of Saudi Arabia" would be needed in extra supply[21]. With production from existing, conventional oil fields predicted to decline by 50% by 2020, the IEA predicts this supply gap will be met by greater demand for both coal and "unconventional" oil, with the latter providing around 11% of total oil output by 2030[22].

Over half this amount will come from tar sands in Canada, which are currently the principal oil import into the USA.

figure 1. Global unconventional oil resources



Source: Modified from *Oil Shales of the World: Their Origin, Occurence, and Exploitation* by Paul. L. Russell and UNITAR Heavy Oil & Oil Sands database.

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Tar sands (called "oil sands" by the oil industry) are deposits of sand and clay saturated with bitumen - oil in a solid or semi-solid state. Huge amounts of energy (fossil fuels) and water are required to extract and then process, or "upgrade", the bitumen to turn it into synthetic crude and other more economic products.

Canada's tar sands deposits, located in the province of Alberta, are the second largest oil deposits in the world, covering an area bigger than England that includes over 4 million hectares of boreal forest. Tar sands development has been heavily criticised for the local environmental and social destruction it has caused, along with its high carbon footprint.

One study comparing the GHG emissions associated with refining different kinds of crude found that, in general, heavier crudes require more energy to refine and result in greater GHG emissions[23]. Production of crude from Canadian tar sands in particular generates on average 3-5 times more emissions per barrel than conventional oil[24]. BP has recently claimed that its Sunrise project would emit only 5% more GHG emissions than conventional fuels on a well to wheels basis, but the research underpinning this figure was not peer reviewed and used only theoretical data and the dirtiest conventional fuels for comparison[25]. Independent peer reviewed studies find well to wheel GHG emissions are up to 37% to 40% higher than the average for conventional oil[26]. According to the US Department of Energy, Canada's tar sands is the most GHG intensive source of crude oil being used in the United States today[27].

Tar sands development is the fastest growing source of emissions in Canada[28]. In 2007, for instance, Canada's total GHG emissions were 26% higher than 1990 levels and, according to Greenpeace, are now around 34% higher than its agreed Kyoto target[29]. Current estimates may not even be the whole picture, as they do not factor in emissions caused by deforestation. Recent research has estimated that emissions from Canadian tar sands could grow to between 127 and 140 million tonnes by 2020, exceeding the current emissions of a country like Belgium, with a population of ten million people[30].

Apart from destruction of vast swathes of Canada's boreal forest, the highly intensive use of energy and water in tar sands projects has raised concerns, along with increases in water and air pollution. Open cast mining techniques used to extract shallower resources have led to the creation of huge lakes or "tailings ponds" for storing toxic waste matter, for which there is no long-term solution[31]. First Nations communities living downstream from the projects have been most directly impacted. While some have benefited from increased employment opportunities, many people feel that the benefits are outweighed by the environmental and cultural losses. In addition to impacts on subsistence fishing and hunting activities, there are serious concerns about the health impacts of pollution from tar sands developments: one community, Fort Chipewyan, has seen an increase of around 30% in cancer rates[32]. Another local First Nation community, the Beaver Lake Cree Nation, is challenging tar sands developments in the Canadian courts citing over 17,000 violations of their treaty rights to hunt and fish throughout their traditional territories and is seeking to protect the ecological integrity of these lands[33].

Until recently, tar sands were too costly and technically difficult to exploit to make their production on a commercial scale worthwhile, and it is still the case that oil prices must remain high and costs be kept down for production to be profitable. Analysis has shown that an oil price of $70 to $100 is required for production to be profitable, and in the upper range of this figure for the in situ extraction required for deeper deposits (see below)[34]. Investment is currently being slowed by the high development costs, magnified by the effects of the recent slump in oil prices and the credit crunch. However, the trend is still upwardsx[35], with European companies such as Shell, Statoil, Total and BP investing in tar sands. In the case of Shell, tar sands represent around a third of their total global resources, while BP is intending to do a $5 billion asset swap, exchanging 50% of its Toledo refinery for 50% of Husky Energy's "sunrise project"[36].

There are serious question marks over the longer-term financial viability of tar sands developments. Analysts and investors are now asking whether companies are adequately taking into account risks from future carbon prices, low-carbon regulation and oil price volatility. According to the IEA, for instance, it is highly likely that mandatory pricing of carbon emissions will soon be introduced: even under the conservative "450 scenario", the IEA estimates the price of carbon in industrialised countries will rise to $50 per tonne in 2020 and $110 by 2030. This would add $5 and $11 respectively to the average cost of producing a barrel of tar sands[37], thus further threatening the financial viability of many tar sands projects.

Shareholder resolutions introduced at the 2010 AGMs of both Shell and BP asked for "clarity regarding the macro-economic assumptions being made by BP and Shell in deciding to allocate capital to the acquisition and development of oil sands resources"[38]. The investors also cited analysis by Deutsche Bank suggesting that high oil prices may dampen demand, triggering a permanent shift to more energy efficient products and more efficient oil use and substitution[39].

Canada is currently the only country where tar sands are being commercially exploited, but expansion is underway, with European companies at the fore of developments under exploration or planned in Jordan (Shell), Russia (Shell), Republic of Congo (Eni), Venezuela (Repsol) and Madagascar (Total). A bitumen licensing round has also been mooted recently for Nigeria.

1.5 The unaffordable climate and energy security costs of unconventional oil

Despite protestations to the contrary by oil companies and by the Albertan and Canadian governments, the greater carbon footprint of tar sands over conventional crude production is not in doubt. In the medium to long-term, this will increase as tar sands production in Canada expands and also because this expansion will depend on developing the deeper bitumen deposits. These will require what is called *in situ* extraction[40], rather than open cast mining. In situ extraction is more energy and carbon intensive than conventional oil production or mining for tar sands[41]. The Alberta Government has also proposed a policy to allow in situ operations to replace natural gas with higher-carbon fuels to generate the energy they require, which would increase emissions (and dangerous air pollutants)[42]. Thus the average carbon intensity of Canadian tar sands production is set to grow significantly[43].

Oil companies such as Shell claim Carbon Capture and Storage (CCS) and efficiency improvements will reduce the GHG emissions from tar sands production. However, investors and NGOs are now questioning publicly the feasibility of Shell's claims, given both the untested nature of CCS technology and the financial implications of rolling it out on the commercial scale necessary to reduce GHG emissions significantly: "Even if the, as yet unproven, CCS technology proves successful at reducing GHG emissions, the costs could be prohibitively expensive at $110-$290 per tonne"[44]. Investments should go into renewable energy, instead of unproven technologies such as CCS.

Finally, tar sands expansion will not increase either EU or global energy security. It is true that Canada is now the primary oil exporter to the USA, and the largest marginal source of non-OPEC oil supply not controlled by national oil companies. For these reasons it has been claimed that Canadian tar sands represent "an increasingly important part of the fabric of hemispheric and global energy security"[45].

However, OPEC still controls the overwhelming majority of the world's remaining oil reserves (around 70%) and tar sands production in Canada will not substantively change OPEC's share in the global oil market or undermine OPEC's power. Canadian tar sands are not a tap that can be turned on easily when other sources of supply fail, by virtue of their vast infrastructure requirements, highly capital-intensive nature and lack of spare capacity[46].

Overall, the strategic wisdom of spending billions on developing tar sands in Canada – or elsewhere – when there is little evidence this investment will ensure a safe return for investors or enhance energy security for consumers, is highly doubtful. Even if the financial costs were not prohibitive, the carbon costs should be. If all North America's unconventional oil reserves were fully developed, including oil shales – as under the IEA's reference scenario, which is essentially the basis for the future demand projections of oil companies such as Shell - the total emissions released would be "equivalent to 20 years of global emissions at 2004 level"[47]. On this trajectory, a catastrophic rise in global temperature is inevitable.

It was recently estimated that around US$379 billion will be invested in Canadian tar sands alone in the period to 2025[48]. Some argue such vast sums would be better spent on financing the shift to a low-carbon economy and on efforts to meet the Millennium Development Goals (MDGs). To meet EU targets for wind energy, for instance (20% of electricity demand by 2020 and 34% by 2030) annual investment needs to increase from €11bn in 2008 to just below €25bn annually up to 2030. Equally, $379 billion could provide every child globally with a place in primary education between now and 2015 (MDG2)[49].

Boreal forest deforestation for tar sands expansion
© greenpeace / john woods

1.6 Unconventional oil: undermining EU development objectives

Tar sands development in Canada constitutes a huge threat to climate protection and to the shift to a low-carbon economy that is the basis of future sustainable development not just in Europe but globally. This threat will only intensify if tar sands investment expands to the rest of the world. The experience in Canada has also raised serious concerns at the local level over deforestation and loss of biodiversity, air and water pollution and its attendant health impacts, and damage to the traditional livelihoods and cultural practices of indigenous First Nations communities. Expanding investment in tar sands and other dirtier forms of oil production to non-OECD countries - and in particular to countries that may have weaker political and environmental governance frameworks (for example, the Republic of Congo, see Part 2) - means a greater concomitant risk of irreversible damage to local communities and the environment.

Africa is an important new frontier for unconventional oil exploration. Tar sands investments are underway in the Republic of Congo (Brazzaville) and Madagascar, while Morocco and possibly the Democratic Republic of Congo have as-yet undeveloped oil shale resources. A bitumen licensing round has also been mooted for Nigeria.

Africa's importance as a development partner for the EU is reaffirmed in the Europe *2020 strategy*[50], along with the EU's commitment "to eradicate poverty, to promote growth and to fulfil the Millennium Development Goals (MDGs)"[51]. The latest report on the MDGs by the UN states that only limited progress has been made on MDG 7 Environmental Sustainability since "threats and drivers of biodiversity loss, such as over-consumption, habitat loss, invasive species, pollution and climate change, are not yet being effectively tackled"[52]. Moreover, climate change is not a threat to MDG 7 alone but to achieving all the MDGs, according to the UN, which supports "switching to low greenhouse gas emitting, high-growth pathways" as the only way to ensure "climate-resistant development"[53].

Tar sands development in Africa and globally, which will exacerbate climate damage by its destruction of local biodiversity and its high level of carbon emissions, thus constitutes a particular threat to efforts to achieve the MDGs. As the AU-EU Partnership on Climate Change acknowledges, Africa is particularly vulnerable to climate change, which is why the Partnership advocates "integration of climate change in African development planning and in Africa-EU development cooperation". In light of this, EU – and African - policymakers cannot ignore the risk that high-carbon oil investments in Africa will intensify the climate change impacts that are affecting the continent.

The Africa-EU Energy Partnership (AEEP) stresses the need for Africa to develop its own renewable energy infrastructure and increase its energy efficiency for the benefit of its own citizens, in a continent where (as the AEEP notes) most states are "heavily dependent on energy imports"[54]. Specific joint policy initiatives and investments to promote energy sustainability envisaged by the AEEP include a renewable energy cooperation programme for launch in 2010, the Mediterranean Solar Plan and technical assistance through the International Renewable Energy Agency (IRENA)[55].

In order to effect the shift in Africa (as in the EU) from "unsustainable energy practices [that] can be a cause of environmental degradation: deforestation, indoor and outdoor air pollution, and climate change"[56], the AEEP stresses that gains in energy efficiency must go hand-in-hand with diversification of energy supply, particularly towards renewables: "Africa's huge potential in energy resources - such as hydropower [...] as well as wind resources, solar energy, geothermal energy and biomass – is under exploited, both at the centralised and decentralised levels"[57].

However, the recognition in the EU's 2007 energy policy that tackling climate change by switching to low carbon energy pathways is vital to the EU's energy security sits uneasily alongside the stress on Africa's growing significance as an energy supplier to Europe, where EU energy security is "a central part of all external EU relations"[58]. The AEEP also notes the strategic need "to enhance cooperation with key African [energy] producing countries"[59] – most of which are suppliers of fossil fuels – and to promote the development of export energy connections between Africa and Europe, for example through the Transaharan Gas Pipeline[60].

This reflects an underlying tension to EU-Africa energy relations – between one approach where priority is given to enhancing Africa's role as an important marginal supplier of energy exports for Europe, and another built around supporting Africa's own shift to a low carbon path, and mitigating climate change impacts on the continent[61].

Energy projects undertaken by European corporations and development agencies in Africa have historically been export-oriented and have generally resulted in extremely poor outcomes in terms of reduced poverty and improved governance for the majority of citizens in their host countries. This is particularly the case in oil-exporting states, which are frequently associated with the so-called "resource curse". Without radical improvements in accountability and transparency, there is no evidence to suggest that the citizens of unconventional oil-exporting states would fare any better. It is essential therefore that future EU energy policy and cooperation with Africa adequately takes into account the climate and energy security costs of future energy investments in the continent – both locally and

globally – and ensures that these projects prioritise the interests of host communities, not just those of European consumers and energy companies.

The EU has already acknowledged that it is not enough to consider sustainable development in Europe in isolation. This also requires "a concern for and active engagement in the sustainable development of the rest of the planet"[62]. In the case of new export-driven and highly carbon intensive developments, such as the multi-billion dollar investment by Italian company Eni in the Republic of Congo, it is unclear how they will advance either European consumers or Congolese citizens along the path to a sustainable low-carbon future, nor help the latter achieve the MDGs. Again, it can be argued that the vast amounts of financing likely to be invested in supporting tar sands development over the next decade could be more usefully redirected towards efforts to achieve MDG 7 on environmental sustainability, and the other MDGs[63].

1.7 Discouraging unconventional oil from entering the EU

Given the manifold risks of continued reliance on conventional fossil fuels, let alone expansion into unconventional oil, FoEE believes that the EU should actively discourage such high carbon products from entering primary markets, and that this should be done before unconventional oil production goes global. Current levels of tar sand imports into the EU are low, but planned expansion of production in Canada and increased pipeline and refining capacity in the US mean that much greater levels of tar sands imports could soon start to enter the EU, particularly if development spreads worldwide.

Transportation is a key sector for improvements in energy sustainability and efficiency[64]. It is currently responsible for 32% of the EU's carbon emissions, and is the sector with the fastest emissions growth[65]. According to the EU's 2009 sustainable transport communication (which inexplicably makes only passing reference to climate change), the EU transport sector is still 97% dependent on fossil fuels[66].

A further compelling reason why the EU must also show leadership on promoting a low-carbon transport sector is because EU standards on the environment and transport have been adopted in other parts of the world, such as Asia[67]. The EU's role as a global "standard setter" is recognised in the sustainable transport policy communication: "Europe must pave the way to sustainable mobility, where possible providing solutions that are valid on a global scale and that can be exported to other regions of the world"[68].

The state of California has already taken a step in this direction by introducing a 10% target for low carbon transport fuels in 2007, while in the same year the US Congress passed the Energy Security and Independence Act. Section 526 of the Act forbids federal agencies from sourcing fuel from unconventional sources unless their lifecycle GHG emissions are less or equal to the equivalent conventional oil fuel source[69].

The EU has adopted a similar approach to California through its own 2007 Fuel Quality Directive (FQD). Article 7(a) of the Directive includes a target to reduce lifecycle GHG emissions in the transport sector by 10% by 2020[70]. In principle, this "lifecycle" approach is a step change from other quantitative targets (such as the 10% target in the Renewable Energy Directive), but the success of the FQD in achieving its objective will depend on its implementation methodology.

A lifecycle GHG approach includes all emissions from fuel production: from extraction through refining, distribution and combustion of the fuel ("well-to-wheel" emissions). Combustion accounts for around 2.5 kg of CO_2 emissions per litre of fuel, whatever the fuel source. Refining adds a further 15-20% in emissions per litre, which means that overall, full lifecycle CO_2 emissions are around 2.9 kg of CO_2 emissions per litre of fuel[71].

This means that substantial savings on GHG emissions have to come from how the fuel is produced, refined and distributed ("well-to-tank" emissions). In terms of biofuels, for instance, it has been argued that depending on the type of biofuel used, there is a huge variance in "well-to-wheel" emissions - in the range of 10 to 110%[72]. In terms of fossil fuel production, GHG emissions vary hugely between regions and fields, according to the type of deposit and the extraction and refining technology used[73] - as has been seen in the case of tar sands production, which is 3 to 5 time higher in emissions than conventional crude production. This means that, potentially, extraction and refining offer the chance for significant emissions cuts.

In fact, FoEE believes that the 10% target in Article 7(a) of the Directive can be achieved by focusing solely on reducing emissions from fossil fuel extraction and refining - meaning that controversial biofuel sources would not need to be factored in. Measures would include reducing gas flaring and venting, increasing energy efficiency at refineries and greater use of cogeneration and fuel switching in refineries, as FoEE outlined in its 2008 report *Extracting the Truth*[74]. Other expert groups such as Transport & Environment have also supported the inclusion of efficiency improvements from refineries in the FQD methodology and pointed to ways in which the Commission could evaluate their comparative carbon efficiency[75].

The oil industry, however, has lobbied against both Article 7(a) and any measures to reduce emissions from fossil fuels, promoting the questionable idea that the 10% target can be achieved solely through increasing the supply of biofuels. Many expert sources and civil society groups have argued that first generation agro-fuels have an equal or higher carbon footprint to fossil fuels, through deforestation and indirect land use changes[76].

The Fuel Quality Directive should therefore focus on reducing GHG along the fossil fuel chain. This would mean incentivizing cleaner refining and also lower carbon-intensive methods of extraction, while disincentivizing environmentally damaging methods of fuel production such as tar sands. However, in order to create this incentive, the large variances in the carbon footprints of different types of oil-based fuels entering the EU must be clearly recognised, by assigning values to these fuels that express their different GHG intensities[77].

The Commission's current proposal is to assign a *single* default value for all oil-based fuel imports. Such an approach is highly misleading: tar sands have, on a "well-to-wheel" basis, a higher GHG intensity compared to average US crude ranging from 8% to 37% - in other words, 18% to 49% higher emissions than the current EU draft default value for petrol (85.8 gCO_2eq/MJ)[78]. If the Commission introduces a single value for all oil-based fuels, the GHG intensities of higher-carbon fuels such as tar sands and shale oil will be seriously under-estimated.

Equally, with only one global default value, there is no incentive for refiners to source fuel from producers with lower extraction emissions, nor for producers to seek improvements in extraction technologies: "Refiners would be able to buy low-quality crude or crude from producers with high extraction emissions and will still get the same default value"[79]. Having different values for different kinds of fuel, on the other hand, will maximise the number of ways in which GHG reductions can be achieved across the lifecycle of fuels[80].

As stated in a March 2010 letter by civil society groups to the EU Commissioner for Climate Change: "With these provisions, the European Commission is contradicting the whole purpose of the Directive and seriously undermining efforts to reduce the GHG emissions from transport"[81]. Transport and Environment further suggests that the default values for GHG intensity should be set at conservative levels (i.e. higher than the typical emissions for the product) – both to prevent under-estimation and to incentivise maximum efficiency gains in production for high-carbon intensity crudes[82]. Producers that perform better than the default (by investing in better technology, reducing flaring, switching to cleaner fuels, etc.) would be able to substantiate their performance with evidence[83]. Such an approach would also limit the administrative burden, as "companies would not be forced to calculate the GHG intensity of each consignment of fuels"[84].

In addition, the transparency and accuracy of reporting on the GHG intensity of oil supplies into the EU would improve: refineries, which already analyse the oil that they process, could report on the sources of crude processed by country/region, and on their GHG intensity[85]. Indeed, civil society and expert groups have suggested the Commission should introduce mandatory systems for reporting the carbon intensity of oil down to the project level, arguing that even if such reporting will initially be incomplete, it must begin soon to ensure the necessary transparency for future reviews of the FQD[86].

1.8 Conclusion and recommendations

Overall, as this briefing has shown, global expansion of unconventional oil will hasten potentially catastrophic climate change and is unlikely to contribute to poverty reduction and good governance in the producer countries, nor enhance the energy security of either the producer states or importing regions such as the EU.

As such, tar sands development threatens Europe's climate, energy and development objectives, along with the global transition to a low-carbon world. For these objectives to be credible and effective, EU policymakers should send a clear signal to the market that pursuing unconventional oil development is a dead-end.

Specifically:

- EU policymakers should encourage cleaner fuel production and disincentivise the entry of high-carbon energy products, such as oil derived from tar sands, into the EU through the development of appropriate import regimes (via an instrument like the Fuel Quality Directive).
- No political and financial assistance should be given by the EU or member states to unconventional oil developments, particularly in developing countries with weak governance frameworks. Instead, EU assistance should be directed at promoting low-carbon forms of energy investment and efforts to achieve the MDGs in developing countries.

Rive near the Athabasca Oil Sands Project, Canada.
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Albian Sands Muskeg River Mine, Alberta, Canada
© j. rezac / wwf - uk

European companies involved in unconventional oil development worldwide

2

This section considers the involvement of European companies in tar sands, heavy crude and oil shale projects outside Canada, the current centre of tar sands production. The largest extra-heavy crude deposits in the world are found in the Orinoco basin of Venezuela, but there are also significant deposits of unconventional oil in the Tatarstan region of Russia, in Jordan, and in several African states. The following outlines, where this information is available, the size and location of the deposits, the level of investment so far from European oil companies, and the possible environmental and social impacts of their development. This is not an exhaustive list of worldwide tar sand and oil shale resources, but focuses on the biggest deposits that are likely to involve investment by European companies.

2.1 Key tar sands projects for European companies

2.1.1 Venezuela

Location and size

Venezuela's tar sands are reported to be the largest after Canada, with recoverable oil totalling at least 2.26 trillion barrels. The majority of the deposits are located in the Orinoco river basin. The Venezuelan government estimates that 20% of the Orinoco basin deposits are extractable using current technology, or around 316 billion barrels[87]. Venezuela is already producing more than half a million barrels of oil per day from four existing tar sands developments: Petroanzoategui, Petromonagas, Petrocedeno and Petropiar[88].

About 8-12% of the Orinoco oil is recoverable through mining extraction techniques. The rest of the oil will then be extracted through steam-based in situ production, and potentially "methods involving gas injection and in situ combustion"[89].

The Orinoco basin has been divided into four areas for the purposes of tar sands exploration and development. From west to east, these are called Boyaca, Junin, Ayacucho and Carabobo[90]. European companies are active, to varying degrees, in all four of these permit zones, each of which has been split into several blocks that are being licensed to oil companies. Details about the size and expected production rates of the blocks with European company investment can be found below.ent investigation to assess this is crucial.

Investment and development

Under the Chavez government many changes have been made to the way Venezuela's oil projects are run, generally making it more difficult for European oil companies to operate in the country. At the end of March 2006, the government terminated all existing oil contracts with foreign companies and insisted that they be renegotiated with PDVSA as the majority stakeholder in all projects. Furthermore, a highly controversial nationalization of suppliers followed as PDVSA did not pay debts to oil companies & contractors. The issue of PDVSA's indebtedness is still not transparent.

This led US companies ConocoPhillips and ExxonMobil to pull out of the Orinoco tar sands altogether, although BP, Total and Statoil decided to renegotiate their contracts and continue to operate on their projects, which were already producing oil by this point. Since then, many of the new Orinoco exploration licences have been given to the national oil companies of states that could be considered friendly to the Venezuelan government, although some European companies have also managed to negotiate licenses[91].

BP's main license is the Petromonagas block, which currently produces around 110,000 barrels of oil per day, and may contain up to 1.2 billion barrels in total. BP controls 16.66% of the project, with the rest being held by PDVSA. BP is also developing proposals for commercial production of the Ayacucho 2 block, as part of the conglomerate TNK-BP[92].

The Petrocedeno block is being operated by Total (30.3%) and Statoil (9.7%). The block produces about 170,000 barrels of upgraded oil per day, as well as 6,000 tonnes of coke and 900 tonnes of sulphur daily. Total were also compensated for more than $1 billion by the Venezuelan government for the part-nationalisation of their share in the project[93]. Total and Statoil initially stepped into the gap left by withdrawal of ConocoPhillips in 2006, signing a joint agreement with PDVSA for evaluation of the Petroanzoategui block. Although Total claimed that this agreement "demonstrate[d] the commitment of TOTAL and PDVSA to maintaining their cooperation over the long term", in January 2010 the Ministry of Oil announced that the "Proposals submitted [...] did not meet the requirements", and that consequently PDVSA would be developing the block, which could contain 29 billion barrels of recoverable oil, alone[94].

In January 2010, Italian oil company Eni and PDVSA signed an agreement to develop the Junin 5 block, with Eni holding a 40% stake in the joint venture. This block is one of the most lucrative, with an estimated 35 billion barrels of oil. The plan is to produce 75,000 barrels per day by 2013, with a long-term goal of 240,000 barrels per day, and to construct a new refinery for upgrading as much as 350,000 barrels of tar sands oil per day. Eni is investing $300 million for the project initially, rising to $646 million as the development achieves certain milestones. It is worth noting that the Venezuelan government compensated Eni with a $700 million payment for the nationalisation of the Dacion oil field in 2006[95].

Spanish company Repsol is involved in the Junin 7 and Carabobo 1 blocks. Junin 7 is being developed by Repsol and PDVSA, and holds up to 31 billion barrels of oil, of which 6 billion are recoverable. Production is hoped to peak at 200,000 barrels a day, and to begin in 2012. The Carabobo 1 block is being operated by a consortium including Repsol (11%), Malaysia's Petronas (11%), and the Indian companies Oil and Natural Gas Corporation (11%), Oil India Limited (3.5%), and Indian Oil Corporation (3.5%). The consortium is hoping to produce 480,000 barrels of oil per day at full production, and is also expected to build an upgrading facility to be located at Soledad, Anzoategui state[96].

Galp Energia of Portugal have a contract to evaluate the feasibility of developing the Boyaca 6 block, although these blocks are currently further from development than many of the above mentioned areas[97]. European companies from outside the EU are also involved in the Orinoco development, with state oil company Belarusneft working on the Junin 1 block, and Russian companies Lukoil, NKK, and Gazprom involved with the Junin 3, Junin 6 and Ayacucho 3 blocks respectively[98].

Environmental and social issues

The social impact of oil exploitation in Venezuela can be argued to have had both positive and negative aspects since the Chavez government came to power. On the positive side, the state-owned Petroleos de Venezuela (PDVSA), which holds a majority stake in all oil projects in the country, must spend at least 10% of its annual investment budget on social programmes. Some of this money was intended to be spent on free health care, discounted food for poor neighbourhoods, job creation programmes, education, indigenous land-titling, and discounted oil prices for exports to neighbouring Caribbean countries and some areas of the US[99].

On the other hand, almost half of PDVSA's staff went on strike in 2002 in protest at a new Chavez-appointed board of directors. Following this, 18,000 workers were fired and the International Labour Organisation called for an independent investigation into allegations by the workers of detention and torture. Chavez has now strengthened the links between PDVSA and his executive, with the current PDVSA President Rafael Ramirez – who is also the Minister for Petroleum - telling managers that PDVSA is "red from top to bottom [....] Those who do not feel comfortable [supporting Chavez] should give their jobs to a Bolivarian"[100].

The most obvious environmental issue, apart from the potential recurrence of the local environmental damage associated with tar sands production in Canada, is the sheer size of the deposits being explored, which will mean the release of huge amounts of GHG into the atmosphere.

2.1.2 Madagascar

Location and size

The two most developed tar sands fields in Madagascar are Bemolanga and Tsimiroro, both of which are located in the western Melaky region of Mahajanga province. Both fields are approximately 70km^2 in area[101].

The Bemolanga field is estimated to contain over 16.5 billion barrels of oil-in-place, with almost 10 billion barrels recoverable. Madagascar Oil, a Houston-based independent company which is currently the largest onshore oil operator in the country, estimates that at full production the site could produce as much as 180,000 barrels per day over 30 years. The depth of the Bemolanga field is on average just 15 metres below the surface, making it ideal for opencast mining[102].

Estimates of the resources of the Tsimiroro field vary. Madagascar Oil's own highest estimate is of 4.5 billion barrels of oil in place with a production capacity of 100,000 barrels per day over 20+ years. However, an independent estimate in 2009 was of only 3.5 billion barrels in place, with 900 million barrels recoverable. The depth of the field is between 40 and 300 metres below the surface, so the oil needs to be extracted through steam-based in situ production[103].

Investment and development

The Tsimiroro field is 100% owned by Madagascar Oil, while the Bemolanga field is owned 60% by Total and 40% by

Madagascar Oil. A 2008 steam injection pilot project at Tsimiroro produced 150-200 barrels a day, and Madagascar Oil drilled 50 wells in the area in 2007 and 2008. From 2010, the joint venture will be running another pilot project, this time for three years, before deciding whether to proceed with commercially developing the field[104].

Total paid $100 million for its 60% share in the Bemolanga field in September 2008, becoming its sole operator and "agree[ing] to a 2 year work program to drill 130 additional core wells at a cost of $200 million." It is estimated that the development of the field will cost somewhere between $5-10 billion. On its website, Total claims that "[a]ppraisal work is being conducted to confirm that the license has sufficient resources to underpin a mining operation, starting in 2020, to produce a potential 200,000 barrels per day"[105].

The Production Sharing Contract (PSC) signed for both projects by Madagascar Oil with the government of Madagascar is perhaps even more heavily biased in favour of the oil companies than the similarly exploitative Kashagan oil field PSC in Kazakhstan[106]. 90% of the recovered oil is considered Cost Oil (that is, it goes to the oil companies to cover the costs of their investment), with the remaining 10% of oil produced divided 90/10 between the company and the government for the first ten years of the contract, 80/20 for the following ten, 70/30 for the next decade, and 60/40 for the remaining life of the field, meaning that after thirty years of commercial exploitation the government of Madagascar will receive only 4% of the oil. Madagascar Oil's view that the contracts "were negotiated at a very favourable time and contain attractive terms and conditions" is something of an understatement[107].

Environmental and social issues

On the western edge of the Tsimiroro field is the 1,520km^2 Tsingy de Bemeraha nature reserve, a UNESCO World Heritage site since 1990. The area was awarded UNESCO status because of its limestone karst landscapes, undisturbed forests, mangrove swamps and rare animal species (it is the only place in the world where the armoured leaf chameleon can be found). Around half of the reserve is designated as a "strict" or "integral" reserve, meaning no development or tourism is allowed. Despite this, UNEP claim that "there is no management plan or zoning [...] boundaries are not marked [...] [n]o effort is made to patrol the Reserve or prevent legal infractions"[108]. East of Bemolanga lies the smaller reserve of Ambohijanahary. There is little public information about this area, and what little there is highlights that its only real protection is its inaccessibility[109]. Madagascar is a highly biodiverse country, with up to two-thirds of its species being endemic to the country.

Western Madagascar is very sparsely populated, with a density of 0 to 4 people per km^2. The commune of Ankisatra, the location of the Tsimiroro field, has a population of less than 3,000[110]. While the low population means less people are at risk of displacement because of the tar sands projects, it also means that the few people who do live in the area have less ability to defend themselves against that potential displacement. Further risk multipliers include the the high levels of poverty in Madagascar (the World Food Programme claims 60% of the country is 'extremely poor'), and the low levels of education[111].

In addition, the political situation in Madagascar is unstable. The current government is considered illegitimate by the United States and the European Union, and is suspended from the African Union, having come to power via a military coup d'etat in March 2009. Talks to form an inclusive transitional government fell apart in December 2009, and it is unclear whether any environmental and social issues relating to the tar sands development will be dealt with in a transparent manner[112].

2.1.3 The Republic of Congo (Congo-Brazzaville)

Location and size

On 19 May 2008, Eni and the Republic of Congo Energy Ministry signed draft agreements to invest in tar sands, palm oil and electricity in the country. The agreement gives Eni the right to explore for tar sands over 1,790km^2 in the south of the country near the oil capital of Pointe-Noire[113]. The huge permit area stretches from the border with the Angolan exclave of Cabinda to the Conakouati-Douli national park bordering Gabon.

Investment and development

Eni is investing around €3 billion in its 3 projects and has carried out initial sampling studies on the tar sands zone. The company states that the area contains at least 500 million barrels risked, with the potential for discovering up to 2.5 billion barrels (unrisked). The resources are deep, in the 100-200m range, so are likely to require in situ technology to develop[114].

Environmental and social issues

Eni has stated publicly that none of its tar sands development will take place on rainforest or other areas of high biodiversity and will not involve resettlement of people, as this would contradict its own policies. However, internal studies by the company reveal that the tar sands zone is up to 70% tropical forest and other highly bio-diverse areas, and contains human settlements.

The company has also stated that it will not use any extraction and upgrading methods currently being employed in Canadian tar sands projects, but has not said not what technologies it *will* use. Without this information, it is impossible to predict the project's impacts on local communities and the local environment. However, given the location and depth of the resource, these are potentially devastating.

The country is around 60% forested and Congo's forests are not only a key resource for local people but also a giant carbon sink that plays a vital role in climate protection. The permit zone is also near the Conakouati-Douli National Park, which is the most ecologically diverse habitat in Congo, containing a number of threatened species, and extends into the Dimonika biosphere, a UNESCO-recognised area[115].

A further issue of contention is Eni's plan to claim carbon credits under the UN Clean Development Mechanism for the new power station it will build as part of its investment, claiming that it will reduce emissions from gas flaring at Eni's M'Boundi oil field. However, gas flaring is already illegal under Congolese law, so it is unclear why the project should qualify. In addition, the plant will be producing energy for Eni's high carbon-emitting tar sands project[116].

From a social perspective, Congo is a paradigmatic example of the "resource curse", where billions of dollars in revenues from oil wealth has not resulted in better governance or poverty reduction for its citizens. The *Index of African Governance* ranks Congo as one of the ten worst-performing countries in terms of environmental and human rights protection and transparent management of natural resources. This lack of transparency is also evident in Eni's project, as the agreements between the company and the government are not in the public domain and Eni has not yet carried out any consultation or engagement with communities in the affected areas on the tar sands project[117].

2.1.4 Russian Federation

Location and size

The main areas of tar sands deposits in Russia are the basins of Volga-Ural, Timan-Pechora, North Caucasus-Mangyshlak and Tunguska. The Tunguska basin is the largest by far, but is located in a very remote region of Siberia. Of the others, the Volga-Urals deposit, in the province of Tatarstan, is the most explored.

Estimates of the total size of Russia's tar sands resources vary wildly. The World Energy Council lists Russia as having 177 million barrels of discovered tar sands in place, but notes that the Tunguska basin could contain an enormous amount of oil, perhaps more than 51 billion barrels. The European Commission, however, assigns 260 billion barrels of total tar sands resources to Russia, with 34 billion barrels recoverable, while noting "the lack of accurate and up-to-date information about these reserves"[118]. Tatneft, the Tatarstan state oil company, controls deposits that are between 50 and 250 metres in depth, and which contain a conservative estimate of 50 million tonnes of tar sands resources, with potentially up to 7 billion tonnes of recoverable tar sands oil[119].

Investment and development

An agreement between Tatneft and Shell was first signed in September 2007, with the two companies agreeing to conduct a feasibility study and assess potential technologies for extracting and processing the tar sands in Tatarstan. A joint venture to exploit the reserves went into operation in mid-2008, and hopes to produce 100,000 barrels a day at twelve bitumen deposits[120]. Tatneft are intending to build a plant for upgrading 300,000 tonnes of tar sands a year, and a test project has been run for in situ production of the deposits. In 2009, over 18,000 tonnes of tar sands were processed at the main field, Ashalchinskoye, and Tatneft is continuing to expand operations on this field by drilling more wells[121].

2.2 Oil shale projects

Oil shale is another kind of unconventional oil, different to the bituminous tar sands found in Canada, Venezuela, and other countries mentioned above. Instead, oil shale is a rock containing kerogen from which synthetic crude oil can be extracted by heating it to very high temperatures. However, while it is not geologically the same as tar sands, it is extracted in the same destructive manner – either through surface mining, or through heating the rocks underground in an in situ process, which results in very high emissions of GHG.

2.2.1 Jordan

Location and size

Oil shale covers as much as 60% of the geographical area of Jordan, and it is estimated that the in-place reserves amount to 5.2 billion tonnes and 34.2 billion barrels, while the total recoverable reserves throughout the country could be as much as 50 billion tonnes. The vast majority of this shale is at shallow depths, allowing it to be surface mined. The most explored deposits are Al Lajjun, Sultani and Juref ed Darawish, all of which are located in central Jordan. Of these blocks, the closest to commercial production is Al Lajjun, which covers a 20km^2 area and could contain up to 1.3 billion tonnes of shale.

Another important deposit is the Attarat block, to the east of Al Lajjun, which is being explored by Anglo-Jordanian company Jordan Energy and Mining Limited (see below). This deposit covers 670km^2 and contains up to 11 billion tonnes of shale. The biggest deposit of all is the Yarmouk deposit, a relatively-unexplored zone which crosses the border into Syria and where the deposit may reach as much as 400 metres in thickness[122].

Investment and development

The Jordanian government believes that oil shale "occup[ies] a very prominent position in the national energy agenda" and to be "the most appropriate option that suits Jordan's economy in the near future"[123]. It has promised to sign long-term purchase agreements for the results of any exploration, and to facilitate the necessary logistics for such projects, making it a very attractive location for European companies interested in oil shale.

Shell signed a Memorandum of Understanding (MOU) with the government in June 2006, and finalised negotiations in 2009. It will be operating on the Azraq and Al Jafr blocks via its subsidiary Jordan Oil Shale Company (Josco). The concession area covers 20,000km^2, and Shell has paid at least $340 million for the project, with a total estimated development cost of $20-25 billion. The oil shale deposits in this area are much deeper than in other parts of Jordan, so Josco is testing an In Situ Conversion Process (ICP) technology to process the shale while still in the ground, without the need for mining. The work will begin with three years of exploration, followed by a four-year evaluation period to determine the feasibility of commercial production. It is expected to take between 15 and 20 years before commercial amounts of shale are produced[124].

In November 2006 Eesti Energia of Estonia was awarded a licence to explore 300 million tonnes of the Al Lajjun deposit, under the name of Oil Shale Energy of Jordan, finally estimating a production of up to 36,000 barrels of oil per day. As part of its agreement, Eesti will build a 600MW power plant in Jordan to utilise the shale, with a potential cost of $1 billion. This plant is expected to be operational by 2015[125].

Jordan Energy and Mining Limited (JEML), an Anglo-Jordanian company, also has a license to work on the Al Lajjun deposit, as well as the Attarat deposit. JEML are said to be investing up to $2 billion in the project, and they expect to have a commercially operational plant in Al Lajjun, with a production of 15,000 barrels per day, as soon as 2012[126].

Environmental and social issues

The most pressing environmental issue in Jordan is water supply. Jordan is one of the driest countries on earth, forecast to have a water shortage of 320 million cubic metres in 2010 and to have a consumption rate twice the size of its naturally available water resources by 2020. Oil shale production will exacerbate this trend hugely, as one barrel of shale oil requires as much as 3.2 barrels of water to upgrade. A 100,000 barrel a day shale industry could consume 18.9 million cubic metres of water every year, as much as the entire Jordanian city of Zarqa, with a population of 450,000. If the shale is used to produce electricity – which is a strong possibility - the amount of water required would increase by a further 35%.

Aerial view of a tailings pipe at the Syncrude upgrader plant and tailings pond in the Boreal forest north of Fort McMurray. © greenpeace / jiri rezac

The aquifer that runs beside the Al Lajjun deposit does not have the capacity to support both the population of Amman and central Jordan and the mining activities, so water will have to be found elsewhere[127]. One possible source of water will be the proposed Red Sea-Dead Sea Canal, which is being designed to pump water 200km from one sea to the other, primarily as a source to cool nuclear reactors. The $10 billion project is already being heavily criticised for the damage it may cause to coral reefs in the Red Sea and potential wider impacts on the ecosystem of the Jordan valley[128].

Further environmental concerns relate to the potential release of toxic gases during mining, processing and upgrading, waste disposal issues and the potential dangers of the in situ shale processing method being developed by Shell. Its potential disadvantages include "high demand for electricity and water, surface subsidence, groundwater contamination, and difficulty reaching the underground waste disposal areas in case something goes wrong"[129].

The social impacts of oil shale developments are also a concern. For instance, Jordan Energy and Mining expect to provide 2,400 people with unskilled and semi-skilled employment in the area, as well as potentially investing in training. However, they will also seal off the project area to nomadic peoples, probably affecting a nearby community of 800 people currently located 2km from the site. The company claims that any displaced people will be compensated in accordance with Jordanian law, but it remains to be seen how this will be dealt with in practice[130].

2.2.2 Morocco

Location and size

There are ten oil shale deposits in Morocco, and the three most-explored (and therefore the most likely to begin commercial production in the near future) are Tangier, near the Mediterranean sea, Timahdit, to the east of the capital Rabat and Tarfaya, on the border between Morocco and Western Sahara. Morocco's total in place oil shale reserves are estimated at between 50 and 55 billion barrels.

The Timahdit zone is approximately 196km^2 and contains an estimated 16.1 billion barrels of oil in place. Tarfaya is around 2,000km^2, with 22.7 billion barrels of oil[131]. The thickness of the Timahdit shale is between 80 and 250 metres and Tarfaya between 22 and 28 metres. While Tarfaya is shallow enough to be entirely developed potentially with surface mining, Timahdit will require a combination of mining and in situ production. The Tangier deposit, at a thickness between a few centimetres and 8 metres, contains an estimated 2 billion barrels of oil[132].

Investment and development

Morocco is highly dependent on energy imports, hence the government's interest in exploiting their domestic deposits of oil shale. Omar Bekri, a former head of Research and Development at the Moroccan National Oil Company, estimates that with a production of 50,000 barrels per day from shale, more than 40% of Morocco's energy consumption would be covered. Because of this, the National Office of Hydrocarbons and Mines (ONHYM) claims that "[t]he Moroccan authorities have decided to elaborate a new legal and attractive fiscal framework for the oil shale projects" to encourage large oil companies to invest[133].

In 2008 ONHYM employed Brazilian state oil company Petrobras to evaluate the Timahdit deposit in the hope of confirming the studies done in the 1980s and to assess the feasibility of developing the deposit. Total has since joined this project by signing a cooperation agreement with Petrobras, stating: "Petrobras owns an oil shale extraction process [....] Total, meanwhile, has state-of-the-art oil upgrading technology and deep knowledge of the region"[134].

In July 2009, Irish oil company San Leon Energy announced it had signed a three year MOU with ONHYM to use "In-Situ Vapour Extraction (IVE) technology" on the Tarfaya deposit. The first testing phase is due for completion by mid-to-late 2010[135].

ONHYM has also signed an MOU regarding the Tarfaya field with a company called Xtract and a "confidentiality agreement" on the Tangier field with a company called Enefit. Xtract Energy is a London-based multinational energy company, which owns 70% of Xtract Energy (Oil Shale) Morocco, with the other 30% stake being held by Prince Bandar of Saudi Arabia. The MOU is for the "evaluation and possible development of an oil shale deposit near Tarfaya". However, "in light of market turmoil and falling oil prices, no significant work [has been] done by the joint venture [....] Since July 2009, investment conditions have started to improve and it is hoped that work can begin during the current financial year"[136]. Enefit is the Latvian subsidiary of Estonian company Eesti Energia. There is little information about their agreement with ONHYM, but the CEO of Eesti states that "[c]onfident of our success in Jordan, we are ready to export our unique oil shale production know-how to other countries interested in oil shale utilisation such as Morocco"[137].

Environmental and social issues

The Tarfaya deposit spans the border between Morocco and the territory of Western Sahara, a sparsely populated region that is the centre of an ongoing political dispute. Since the withdrawal of the colonial power, Spain, in 1975, there has been an ongoing war between the independence movement of Western Sahara (known as the Polisario) and the government of Morocco. Morocco currently controls 80% of

the territory, which it calls its "Southern Provinces", with the remaining "Free Zone" controlled by the Polisario. The Free Zone contains around 30,000 people, and another 90,000 Sahrawis live as refugees in camps around Tindouf, Algeria. The two areas are separated by a defensive – and heavily mined - sand wall built by Morocco.

In 1981, King Hassan of Morocco announced that a referendum would be held on the issue of Western Saharan sovereignty, but this has never taken place. Western Sahara is considered by the UN to be a 'non-self-governing territory'. Despite ongoing demonstrations and riots, Morocco holds firm control of the part of the territory it administers and resource extraction projects are undoubtedly providing revenues and legitimacy for the ongoing occupation of this region[138].

From an environmental perspective, the Timahdit deposit is close to the Ifrane and Haut Atlas Oriental national parks. The former contains the largest Atlas cedar forest and a population of Barbary apes. The latter is heavily used for pastoralism and agriculture, with an estimated 18,000 people using the park's resources as of 1993. The Moroccan government claims to have undertaken environmental studies on both the Timahdit and Tarfaya projects, but the environmental impacts need to be monitored closely to make sure damage is not done to these ecosystems[139].

2.2.3 United States

Location and size

The United States contains by far the largest oil shale deposits in the world, with up to 74% of the world's recoverable oil shale located here, equalling around 2.085 trillion barrels of oil in place. The biggest deposits are found in the 42,700km2 Eocene Green River formation, which covers parts of northwestern Colorado, northeastern Utah, and southwestern Wyoming. The Green River formation contains 70% of the US's total reserves of oil shale, or 1.5 trillion barrels of oil in place, of which 800 billion barrels is currently thought to be recoverable (although studies are still ongoing). The most easily recoverable deposits, and those of the best quality, are found in the Piceance Creek basin in western Colorado, and the Uinta basin of eastern Utah[140]. More than 70% of the oil shale in the Green River formation is in land owned and managed by the government[141].

Investment and development

There has been intermittent interest in the US's oil shale resources in the past, most notably after the second world war and during the 1970s oil crises, but that interest dropped away until in 2004, in response to rising oil prices, the government began to look again at the possibilities for commercial exploitation of the Green River deposits. In 2005, nineteen applications were received for small-scale Research & Development (R&D) leases in Green River – five of these were granted in Colorado in late 2006, and one was provisionally approved for Utah in April 2007. All of the Colorado leases are for in situ production, while the Utah licence is for surface mining[142].

However, while most oil shale deposits in the US were underdeveloped before this time, Shell has been operating on private land in the Piceance Creek basin since 1996, on a development they call the Mahogany Research Project. They are developing an innovative in situ production method that utilises a 'freeze wall' – they circulate ammonia through the rocks that surround the shale production area, freezing the water inside them, and creating an impermeable barrier of ice that is designed to avoid groundwater contamination. Shell hopes to reach a decision on whether to go ahead with commercial production by the middle of the decade, although this decision may be delayed depending on the results of their current research[143].

In 2006, Shell were awarded three more R&D leases in Piceance Creek. These were awarded by the then Interior Secretary Gale Norton, who soon resigned soon afterwards and, in December of the same year, was hired by Shell as in-house counsel to its unconventional fuels division. Norton is now the subject of a Justice Department investigation to determine whether she used her position to give Shell an unfair competitive advantage[144].

In February 2010, further problems hit the project, as Shell withdrew a request it had made for rights to 15 billion gallons of water from the Yampa river, citing "the overall global economic downturn that has affected our project's pace"[145].

Environmental and social issues

The biggest environmental issue around these developments has been the high levels of water usage. One report concluded that the amount of water used by all the companies operating on oil shale projects in northwestern Colorado would be more than is consumed by the entire Denver metropolitan region, with 2.5 million people[146]. Shell has since confirmed that although its in situ process uses less water than surface miing of oil shale, it is still highly water intensive, using three barrels of water for every barrel of oil produced, although they hope this ratio will improve in the next ten to fifteen years[147].

There is a more detailed account of the potential environmental dangers of in situ oil shale production in the section on Jordan below.

2.3 Other selected tar sands and oil shale resources

The following are countries that have large amounts of unconventional oil, but where the exploitation of these resources does not currently have any significant involvement from European companies. Nevertheless, as conventional oil resources dwindle, these countries may well consider inviting European companies, with their technological know-how gained from other projects, to help them in extracting their tar sands and oil shale deposits. Some, such as Nigeria, are already exploring the possibility of doing so.

2.3.1 Nigeria

Location and size

Nigeria's "bitumen belt" is located in the southwest of the country, stretching along 120km of coastline through Lagos, Ondo, Ogun and Edo states. The most important deposits are found in the Ikale region of Ondo state. According to a 2009 presentation by the Minister of Mines, Nigeria's estimated resource is 27 billion barrels of oil equivalent, with proven reserves of 1.1 billion barrels of oil equivalent covering a 17 km^2 area[148].

The Ministry of Mines has divided the exploration area into three blocks, although the exact details of these blocks vary in different reports. One media sources states that "Block A is around 4,170km^2, Block C is approximately 3,707km^2." Another African news site speaks of "three bitumen blocks with a proven reserve of one billion barrels of oil equivalent (boe), 21 billion boe and 43 billion boe" with another referring to the 43 billion barrel deposit as being in the Ikale region[149].

Investment and development

According to the Ministry of Mines, bitumen was first discovered in 1900 and over the past fifty years there have been several exploration efforts. Between 2001 and 2008, 40 core holes were drilled and logged by the Ministry and in 2002, Conoco Energy Nigeria carried out a pre-feasibility and scoping study of the Bitumen Belt[150].

In January 2003 the Nigerian companies Nissand and Beecon were awarded licenses for bitumen blocks 307C and 307B respectively. These licenses were cancelled in 2007 after the companies encountered technical difficulties and had problems raising enough funds. At the time of the licenses being awarded, Environmental Rights Action protested that the agreements were shrouded in secrecy, local communities were not consulted, and no environmental impact assessment was carried out[151]. In 2006 it was reported that Chinese firm Sinopec, in conjunction with Chinese engineering company CGC Overseas, had acquired rights to 'Bitumen Block 2' for $18.6 million. A Mines Ministry spokesman claimed that the sale of another block has been suspended, as the offers received were "ridiculously low"[152].

The 2007 Mining Act has been described by the Ministry of Mines as designed to create an improved "enabling environment" for foreign investment in the sector, including favourable tax and fiscal regimes and "investment friendly" policy and legislation, and a privatization programme to divest the state from the sector. The government stated in 2009 its desire to "rapidly develop the resource for economic and social development" and announced a bidding round on two blocks that was due for completion by September 2009[153].

According to press reports, sixteen companies from the US, Canada, Nigeria, South Africa and China expressed interest in the round[154], and the government also noted prior to the round that it had received interest from "major players". However, whether the bidding was finalised, and its outcome if it was, remains unclear. The project to exploit Nigeria's tar sands deposits appears to be at a standstill, perhaps because of the political crisis at the end of 2009. Nevertheless, given the historical level of investment in conventional oil by multinational oil companies in Nigeria, it seems likely that the unconventional resource will be next for exploitation.

Environmental and social issues

Nigeria is emblematic of the "resource curse" – the phenomenon where countries that are rich in natural resources perform very poorly in terms of human development and suffer from more uneven economic development than regions with less resources[155]. The Nigerian economy is highly dependant on oil and gas, which constituted 83% of all federal government revenues in 2008[156], and the country has accrued around $370 billion in oil wealth since 1965. As a result, Nigeria has suffered from the "Dutch Disease", namely a decline of competitiveness and productivity in the non-oil sectors, high levels of poverty, corruption, poor infrastructure and social services, ongoing conflict between the government and local communities in oil-producing regions, and authoritarian leadership, including, for much of the period between 1983 and 1999, a military dictatorship[157].

The Ikale region of Ondo state is likely to be one of the most affected areas if tar sands production goes ahead. In a 2008 interview Chief Donald Oguntimeyin, the President of the Ikale Central Organisation, states "[o]ur people are naturally tolerant and ready to sacrifice whatever it takes to make development work. What investors will enjoy from our people is total cooperation [...] If the project claims a section

of the land, those affected will understand and move elsewhere," suggesting the possibility of displacement in favour of oil projects[158].

A 2003 conference organised by Environmental Rights Action was attended by representatives from communities in the bitumen belt, and resulted in a very critical communique which stated that "the public has remained largely uninformed about the environmental and social costs of bitumen exploitation and how to mitigate them...relevant government agencies were invited to the programme but characteristically they failed to participate...The local people are angry that neither the government nor the companies granted exploration rights have consulted them...More worryingly, some of the bitumen communities have been pencilled down for relocation to allow for uninterrupted drilling of bitumen...We are worried that government will want to replicate the style and approach it used in the Niger Delta, which has engendered war and terror"[159].

2.3.2 Egypt

Tar sands

Egypt's only tar sands development is at the Issaran field, south of Cairo and near the Gulf of Suez. Part of the resource can be extracted using conventional methods, but there are also 64 million barrels of tar sands-like oil that can only be recovered through in situ steam production. The field was first developed by Scimitar Hydrocarbons and later Rally Energy, but in 2007 Rally sold their interest in the field to the Egypt-based Citadel Capital Company and the Egyptian National Petroleum Company for $868 million. Before this, they had completed two steam production test projects, which had produced 800 barrels per day. Peak production is expected to be 10,000 barrels per day[160].

Oil shale

There are two major oil shale deposits in Egypt. The Safaga-Quseir deposit is found in the phosphate belt of the eastern desert, adjacent to the Red Sea, and contains about 4.5 billion barrels of oil. The Abu Tartour deposit is found in the south of the western desert, and contains 1.2 billion barrels[161]. Until recently, developing the oil shale resources was considered uneconomical, but in 2008 the Ministry of Petroleum "ordered its departments to speed up the review of an economic study that has been prepared [...] to assess oil shale reserves". A Canadian company with experience in the Alberta tar sands, Centurion Energy, has now been contracted to study both deposits and suggest the best way to develop them commercially[162].

2.3.3 Angola

Bengo province – which surrounds the capital, Luanda – contains as much as 4.5 billion barrels of tar sands oil in place. There are currently no plans to develop these deposits, but they will become a more attractive resource once Angola's traditional oil resources start to dwindle[163].

2.3.4 Ethiopia

Ethiopia has 3.89 billion tonnes of oil shale located in Tigray province, which borders Eritrea. A dispute over area has previously led to conflict between the two countries, and the UN decision to award part of the province to Eritrea has left relations in the region very tense, one possible reason for the current lack of interest in exploring this resource. There is also a much smaller deposit of 100-120 million tonnes at the Delbi Moyen coal development, southwest of Addis Ababa, although Ethiopia has plans to utilise this for manufacturing urea fertiliser[164].

2.3.5 Trinidad & Tobago

In 2009 Petrotrin, Trinidad and Tobago's national oil company, was given a license to explore a tar sands deposit at the Parrylands/Guapo field, south of the La Brea Pitch lake, and decide on the feasibility of production. The country's Energy Minister claimed that Trinidad & Tobago has 2 billion barrels of tar sands, although other sources put the figure at closer to 900 million. The Minister also "said Trinidad and Tobago was trying to follow the Canadian model of extraction from the Alberta tar-sands"[165].

Billowing smoke surrounds refineries
© greenpeace / colin o'connor

Logs from clearcuts in Alberta tar sands
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A piece of soil taken from one of the sites explored for tar sands, located on the farmland near the Mboukou village, 70 km from Pointe Noire in the Republic of Congo. **© elena gerebizza, 2009**


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