Point of No Return

The massive climate threats we must avoid

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Contents

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Image Smoke from factories causes severe air pollution in Huolin Gol city, Inner Mongolia, whose economy relies heavily on coal-related industries.

"In 2020, the emissions from the 14 projects showcased in this report – if they were all to go ahead – would raise global CO_2 emissions from fossil fuels by 20% and keep the world on a path towards 5°C to 6°C of warming."

Image Traffic moves through billowing smoke and lingering, passing by oil refineries in Alberta, Canada.

#1

Executive summary

The world is quickly reaching a **Point of No Return** for preventing the worst impacts of climate change. Continuing on the current course will make it difficult, if not impossible, to prevent the widespread and catastrophic impacts of climate change. The costs will be substantial: billions spent to deal with the destruction of extreme weather events, untold human suffering, and the deaths of tens of millions from the impacts by as soon as 2030[1].

With total disregard for this unfolding global disaster, the fossil fuel industry is planning 14 massive coal, oil and gas projects that would produce as much new carbon dioxide (CO_2) emissions in 2020 as the entire US[2], and delay action on climate change for more than a decade. The 14 massive projects discussed in this report would add a total of 300 billion tonnes of CO_2 equivalent (Gt CO_2 e) of new emissions to the atmosphere by 2050 from the extraction, production and burning of 49,600 million tonnes of coal, 29,400 billion cubic metres of natural gas and 260,000 million barrels of oil. This represents an enormous increase in new fossil fuels, and an enormous increase in the impact on the global atmosphere. The research for this new report was carried out by Ecofys, a consulting company expert in sustainable energy solutions and climate policies.

Burning the coal, oil and gas from these 14 projects would significantly push emissions over what climate scientists have identified as the "carbon budget", the amount of additional CO_2 that must not be exceeded if we are to keep climate change from spiralling out of control. The crucial period is the time until 2020.

In 2020, the emissions from the 14 projects showcased in this report – if they all were to go ahead – would raise global CO_2 emissions from fossil fuels by 20% and keep the world on a path towards 5°C to 6°C of warming. To avoid the worst impacts of climate change, the rise in global temperatures needs to be limited to below 2°C. Therefore, the addition of CO_2 of this magnitude in the next few years would push the climate beyond the point of no return, locking the world into a scenario leading to catastrophic climate change, and ensuring that we run out of time.

Emissions are already out of control. According to the International Energy Agency (IEA) global CO_2 emissions increased by 5% in 2010 for the largest recorded absolute increase, and went on to grow by over 3% in 2011, exceeding worst-case projections that would lead to 5°C to 6°C of long-term warming[3]. To avoid locking us into catastrophic warming, the building of new fossil fuel infrastructure needs to stop within five years[4] – placing the planned dirty energy projects in direct conflict with a livable climate.

The 14 dirty energy projects in this report range from massive expansion of coal mining in China, to large-scale expansion of coal exports from Australia, the US and Indonesia, to the development of risky unconventional sources of oil in the tar sands of Canada, in the Arctic, in the ocean off the coast of Brazil, in Iraq, in the Gulf of Mexico and in Kazakhstan, and to gas production in Africa and the Caspian Sea. They are the biggest dirty energy projects planned in the coming decades.[5]

For more than two decades, climate scientists have warned that, unless heat-trapping emissions are reduced significantly, severe consequences from climate change will follow.[6] Avoiding the worst impacts means limiting the rise in global temperatures to below 2°C – in itself an extremely rapid change compared with the Earth's past. In November 2012, both the International Energy Agency (IEA) and the World Bank cautioned that the world is heading to a temperature increase of between 3.6°C and 4ºC.[7] With the additional CO_2 from these 14 projects, the average global temperature will more likely exceed 4°C and quite possibly 6ºC – the worst scenarios identified by climate scientists.

Yet, a handful of governments and a small number of companies in the fossil fuel industry are pushing these projects, apparently without a care about the climate consequences. In November 2012, the IEA said in its annual World Energy Outlook that no more than one-third of the carbon contained in the proven reserves of fossil fuels can be released into the atmosphere by 2050 if the world is to achieve the 2°C goal.[8] The development of these new coal, oil and gas projects would come at a time when climate scientists are increasingly linking alarming extreme weather events to climate change.[9] These extreme weather events include Hurricane Sandy in October 2012[10], droughts in the US in 2012[11] and 2011[12], heat waves and forest fires in Russia in 2010[13], and the European heat wave in 2003 that killed tens of thousands[14]. The disasters the world is experiencing now are happening at a time when the average global temperature has increased by 0.8ºC[15], and they are just a taste of our future if greenhouse gas emissions continue to balloon.

The impact on people if we trigger catastrophic climate change will be terrible. In September 2012, a new report, commissioned by 20 governments, gave an insight into the disaster that is coming. It estimated that climate change is already taking 5 million lives a year. By 2030, deaths could total 100 million.[16]

Ecofys' research identifies pathways to climate disaster and pathways to avoid climate chaos.

The most attractive avoidance pathway identified by Ecofys shows there is still a 75% chance of keeping the increase in the average global temperature below 2°C if actions are taken now to reduce emissions. This would not be easy, but it is possible. One of the key actions is to avoid the massive new emissions from the 14 projects in this report. It would also require governments to do what they have promised and reduce global emissions. The Ecofys 75% pathway requires ensuring emissions peak by 2015 and then drop by 5% annually.[17] The new CO_2 emissions avoided by cancelling these dirty energy projects would cover about one third of the total reductions needed to head off catastrophic climate change.[18]

The huge gap between what governments say they are doing to prevent catastrophic climate change and what they are actually doing is most evident with these 14 projects. The governments that have approved them have all agreed that the global average temperature must be kept below 2°C.

If the governments supporting the projects in this report help push the world past the point of no return, the great irony will be that the resulting climate chaos was preventable. The technology for avoiding the emissions from these projects and for reducing overall global emissions exists right now.

Clean and safe renewable energy, coupled with a much-increased implementation of energy efficiency, can provide the power needed to run the planet and avoid the risks of pushing us ever closer to catastrophic climate change. That is abundantly clear from the astounding progress in the development of renewable energy over the past decade.

In 2011, renewable energy provided over 30% of new electricity production globally, up from less than 5% in 2005.[19] This explosive growth can continue and is by far the best hope for avoiding the most serious impacts of climate change.

The global renewable-energy scenario developed by Greenpeace – the Energy [R]evolution – shows how to deliver the power and mobility the dirty projects are promising, without the emissions and the destruction; not only faster, but also at a lower cost.[20] The scenario indicates that by 2035 renewable energy must increase to 65% of electricity production, and energy efficiency must increase to reduce the impact the world is already seeing from climate change and to avoid the catastrophe of a global average temperature increase of 4°C to 6ºC. The world cannot afford to allow the major new coal projects detailed in this report to go ahead and lock in decades of dirty electricity production, or to allow the oil projects to delay the shift to more sustainable transport systems.

The Greenpeace scenario shows that by 2020 renewable energy could deliver twice as much power as the combined output of the four coal projects highlighted in this report.[21] More efficient cars, plus a switch to cleaner fuels and a much smarter use of energy in power generation, buildings and industry, could save more oil than the seven massive oil projects featured in this report could produce.[22] There would be no need to exploit the oil and gas in the fragile Arctic if the world adopted a clean energy future.

The clean energy future made possible by the dramatic development of renewable energy will only become a reality if governments rein in investments in dirty fossil fuels and support renewable energy.

The world is clearly at a **Point of No Return**: either replace coal, oil and gas with renewable energy, or face a future turned upside down by climate change.

"A handful of governments and a small number of companies in the fossil fuel industry are pushing these projects, apparently without a care about the climate consequences."

Largest dirty energy expansions by 2020

Total new CO_2 emissions = 6,340 million tonnes a year by 2020.

Source: Ecofys


of
KAZAKHSTAN
290
CASPIAN SEA
240
CHINA'S WESTERN PROVINCES
1,400
INDONESIA
460
IRAQ
420
AUSTRALIA
760

Image Aerial view of Syncrude's Aurora tar sands mine, in the Boreal forest north of Fort McMurray, Alberta, Canada.


© JIRI REZAC/ GREENPEACE

#2

The world's biggest dirty energy projects

The world continues to burn coal, oil and gas at alarming rates. The appetite for burning these dangerous fossil fuels increases, despite years of warnings from climate scientists that continued burning and high levels of carbon dioxide emissions will cause catastrophic climate change.

In 2009, the world leaders attending the UN climate conference in Copenhagen agreed that emissions must be reduced, and promised the world they would take action.[23] In 2010 and 2011, the immediate years after the conference, CO_2 emissions grew twice as fast[24] as the worst-case projections leading to 6°C warming. The world is rapidly nearing the point of no return for preventing the climate chaos that will affect us all, and cause untold human suffering.

This report examines the impact that 14 massive coal, oil and gas extraction projects would have on climate change if they were to be implemented. Together, the emissions from burning the coal, oil and gas from these extraction projects would add an enormous 300 billion tonnes of CO_2 equivalent ($GtCO_2e$) emissions to the atmosphere by 2050. Of immediate concern is the impact these projects would have up until 2020, the period when significant reductions must happen to avoid the point of no return.

These projects would add 6.34 gigatonnes (Gt)[25] of new emissions to the atmosphere in 2020, more new CO_2 emissions than the total emissions produced annually by the US.[26] The result would be a 20% increase in global emissions at a time when there is an urgent need for emissions to start decreasing.

In 2011, when the IEA announced the record high global emissions of 31.2Gt, it projected that emissions will grow "to 37.0Gt in 2035, pointing to a long-term average temperature increase of 3.6°C,[27] even assuming that emission reduction and clean energy ambitions announced to date are fully implemented. In November 2012, both the IEA and the World Bank released reports indicating that the world is clearly heading for climate catastrophe.[28]

In its news release, the World Bank put the threat of climate change succinctly: "The world is barrelling down a path to heat up by 4°C at the end of the century if the global community fails to act on climate change, triggering a cascade of cataclysmic changes that include extreme heat-waves, declining global food stocks and a sea-level rise affecting hundreds of millions of people, according to a new scientific report released today that was commissioned by the World Bank."[29]

The additional 6Gt of emissions from these 14 projects makes the scenarios of the IEA and the World Bank that are leading to catastrophic climate change look even worse.

The significant increase that would result from adding the emissions of the 14 projects would lock the world onto a path to an average global temperature increase of more than 2ºC. As the IEA has suggested, it is more than likely that these new emissions will cause the global average temperature to soar to 4°C and quite possibly to 6ºC of global warming. These projects have the potential to ensure the world is irretrievably on course to suffer extreme weather events, increased conflict, reduced availability of food and water, and potentially catastrophic disruption.

Climate scientists have identified a "carbon budget," an amount of additional CO_2 that must not be exceeded to keep global warming from overshooting dangerous limits. In November 2012, the IEA said in its annual World Energy Outlook that no more than one-third of the carbon contained in the proven reserves of fossil fuels can be released into the atmosphere by 2050 if the world is to achieve the 2°C goal.[30] The 14 projects alone would eat up 30% of the carbon budget by 2050, and would ensure total emissions exceed the limits.

The world is heading towards climate chaos because a handful of governments and a small number of companies in the fossil fuel industry are pushing these 14 projects, apparently without any regard for the climate consequences. In the case of the governments, their actions are also without regard for their promises to curb emissions.

Climate change is arguably the gravest environmental challenge facing the world now. Unchecked, climate change will cause significant human suffering and economic problems. The climate is now being altered by the CO_2 emissions that have been pumped into our atmosphere for more than a century.

Climate scientists are largely in agreement that climate change, caused by our burning of coal, oil and gas, is already having severe consequences. These consequences are coming at a time when the increase in the global average temperature is about 0.8ºC, well below the level of 2ºC that international climate scientists agree the world must stay under in order to avoid the worst impacts of climate change.

The investment needed for these 14 projects would bring additional coal, oil and gas to market and, as a result, would lock in outdated sources of energy for decades. These projects would undermine the spectacular development of renewable energy around the world over the last few years. They would also wreak havoc on some of the most iconic ecosystems in the world, including the Great Barrier Reef, the Arctic, the Yellow River of China, the Great Bear Rainforest on the west coast of Canada, and the tropical rainforests of Indonesia.

A sign of the world's addiction to fossil fuels is that, even in the face of the clear option to reduce emissions provided by the rise in the impact of renewables, the fossil fuel industry is going after some of the most difficult and dangerous fossil fuels ever to be extracted. Techniques proposed to exploit dirty fuels in the Arctic and off the Brazilian coast have already caused significant accidents[31], such as the disastrous *Deepwater Horizon* spill in the Gulf of Mexico in 2010.

The 14 massive coal, oil and gas extraction projects covered in this report are the worst of the worst. These projects would have the largest emissions of any projects on Earth today and would cause the largest increases in greenhouse gas emissions:[32]

Australia: by 2025, coal exports would increase to 408 million tonnes a year above 2011 levels, pushing associated CO_2 emissions up by 1,200 million tonnes a year once the coal is burned. By then, the CO_2 emissions caused by Australian coal exports would be three times as large as the emissions from Australia's entire domestic energy use.[33]

China: China's five northwestern provinces plan to increase coal production by 620 million tonnes by 2015, generating an additional 1,400 million tonnes of CO_2 a year, almost equal to Russia's emissions in 2010.

The US: plans to export an additional 190 million tonnes of coal a year, mainly through the Pacific Northwest. This would add 420 million tonnes of CO_2 a year to global emissions before 2020; more than the entire CO_2 emissions from fossil fuels in Brazil in 2010.

Indonesia: plans a massive expansion in coal exports from the island of Kalimantan which would add 460 million tonnes of CO_2 a year by 2020, creating dire environmental impacts for the local people and the tropical forests.

Canada: production of oil from the tar sands in Alberta will triple from 1.5 to 4.5 million barrels a day by 2035, adding 706 million tonnes of CO_2 to global emissions a year. By 2020, the tar sands expansion would add annual emissions of 420 million tonnes of CO_2, equal to those of Saudi Arabia.

The Arctic: Oil companies plan to take advantage of melting sea ice in the environmentally sensitive Arctic region to produce up to 8 million barrels a day of oil and gas. If the plan were to succeed, despite mounting technical obstacles and enormous environmental risks, the drilling would add 520 million tonnes of CO_2 a year to global emissions by 2020, as much as the entire national emissions of Canada, and 1,200 million tonnes by 2030.

Brazil: companies intend to extract up to 4 million barrels of oil a day from underneath the Brazilian ocean[34], adding 660 million tonnes of CO_2 to annual global emissions by 2035.

Gulf of Mexico: plans for new deepwater oil drilling would produce 2.1 million barrels of oil a day in 2016, adding 350 million tonnes of CO_2 emissions, equivalent to the emissions of France in 2010.

Venezuela: the Orinoco tar sands will produce 2.3 million barrels of new oil a day by 2035, adding 190 million tonnes of CO_2 in 2020.

The US: new production will deliver 310 billion cubic metres a year of shale gas in 2035, adding 280 million tonnes of CO_2 by 2020.

Kazakhstan: new production in the Caspian Sea will deliver 2.5 million barrels of oil a day by 2025, adding 290 million tonnes of CO_2 in 2020.

Turkmenistan, Azerbaijan and Kazakhstan: new production in the Caspian Sea will deliver 100 billion cubic metres of natural gas by 2020, adding 240 million tonnes of CO_2 emissions

Africa: new production will provide 64 billion cubic metres of natural gas by 2015 and 250 billion cubic metres to 2035, adding 260 million tonnes of CO_2 in 2020

Iraq: new production will deliver 1.9 million barrels of oil a day by 2016 and 4.9 million barrels a day by 2035, adding 420 million tonnes of CO_2 in 2020

A full discussion of selected projects appears in the Appendix to this report, detailing the anticipated production levels and CO_2 emissions, and outlining the significant environmental harm these projects will cause.

These projects are being pushed ahead because the world has not curbed its demand for fossil fuels. The dirty coal-mining projects are driven by the construction of new coal-fired power plants around the world, most importantly in China, India, the EU and Russia, followed by the US, Vietnam, Turkey and South Africa. A report by the World Resources Institute in November 2012 showed that countries are planning to build 1,200 new coal-fired electricity plants, a looming disaster for the climate.[35]

The EU, which has positioned itself as a leader on combating climate change, is also part of the problem of increasing emissions. Its coal consumption and associated CO_2 emissions have grown significantly in the past two years, while its political will to tackle climate change has waned.[36]

While most EU countries don't have plans to extend their reliance on coal, Poland, Germany, Italy, Romania, the Netherlands, the Czech Republic, Bulgaria, Greece, and Slovenia are still allowing the construction of new dirty power stations. As the world's second largest coal importer and oil consumer, the EU must do more to curb its emissions.

The EU needs to regain its leadership in tackling climate change by playing a major role in preventing these massive dirty energy projects from going ahead.[37] The EU has been the historic leader in the roll-out of renewable energy, more fuel-efficient cars and other key clean energy solutions, and it urgently needs to show leadership again in phasing out dirty fuels.

World's worst coal, oil and gas extraction projects

These projects would have the largest emissions of any projects on Earth today and would cause the largest increases in greenhouse gas emissions

Source: Ecofys


29
13,239
11,333
KAZAKHSTAN
TURKMENISTAN, AZERBAIJAN + KAZAKHSTAN
of
24,081
51,734
IRAQ
CHINA
16,014
16,845
INDONESIA
38,374
AFRICA
AUSTRALIA
307,534
TOTAL EMISSIONS TO 2050

Image Maryellen McConnell uses a respirator in and around her Washington County home several days each week because of methane poisoning. She has passed out many times and gone into the hospital. Her farm is on top of an area where gas companies are storing waste materials from hydraulic fracturing drilling in deep underground shale formations.

#3

Calculating the impact of the dirtiest energy projects

The supporting research for this report into the impact of the 14 enormous coal, oil and shale gas extraction projects was carried out by Ecofys, a consulting company well known for its expertise in analysing climate policies and sustainable energy solutions to climate change.

A much-simplified discussion of the Ecofys analysis shows that business-as-usual, including the emissions from the 14 projects, would see cumulative CO_2 emissions of 2,340Gt of CO_2 equivalent (Gt CO_2e) from 2011 to 2050.[38] This is a clear scenario for climate disaster, consistent with a 5-6°C increase in average global temperature.[39]

Current, but woefully inadequate, measures to reduce emissions might cut the global temperature rise to approximately 4ºC,[40] still a "devastating" outcome according to the World Bank.

A carbon budget developed by Ecofys identifies a scenario that shows there is still a 75% chance of keeping the global average temperature increase below 2ºC. To stay within this carbon budget, cumulative emissions between 2010 and 2050 cannot exceed 1,050Gt CO_2e, and global emissions need to start decreasing at the very latest by 2016.

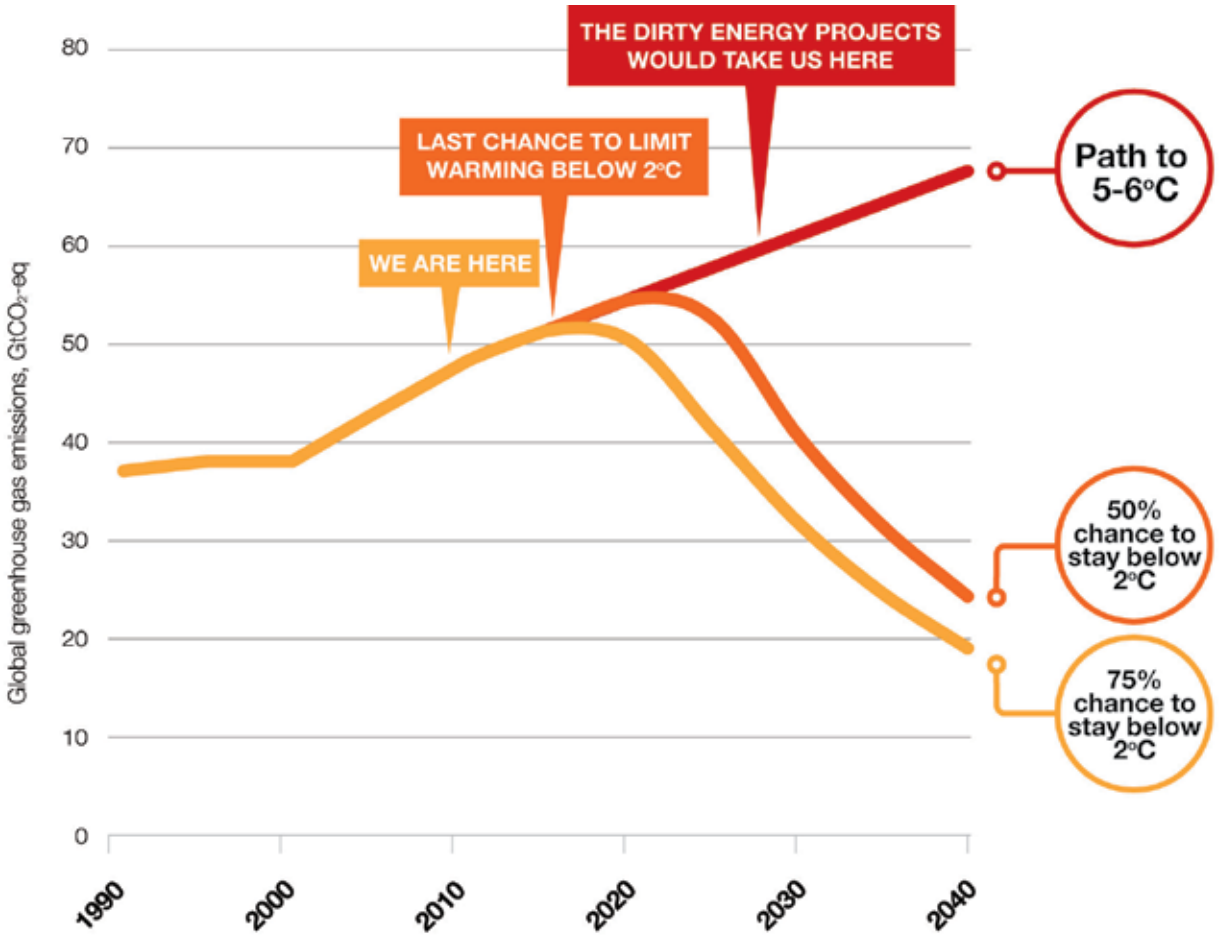
The problem is that investment in energy infrastructure for fossil fuels locks the world into using coal, oil and gas for decades. The IEA estimates that 590Gt CO_2 is already locked in by existing fossil fuel-dependent infrastructure, and building new coal, oil and gas based infrastructure must stop by 2017 to avoid locking in more emissions than can be emitted without overshooting 2ºC warming. After that, the only way to stay below 2ºC warming is to shut down the many new coal, oil and gas power plants and the new coal mines and oil operations that could be operating, making the task of meeting the target hugely expensive and politically difficult.[41] The 14 energy projects would ensure that the dirty energy investments continue well beyond that point of no return.

The growth in fossil fuel consumption driven by the 14 massive projects alone would eat up the remaining carbon budget, when existing lock-in is taken into account: Ecofys calculates the cumulative emissions to 2050 from the 14 projects at 300Gt CO_2e. Put differently, replacing the dirty projects with safe and clean energy would provide almost one third of the reduction needed to have a 75% chance of avoiding climate chaos.

This 75% chance is still available, even though global carbon emissions reached the record highs the IEA calculated in 2010 and 2011, and even though emissions have been growing faster in the last two years than in even the most pessimistic scenarios envisaged by the IEA and the Intergovernmental Panel on Climate Change (IPCC).[42]

Passing the point of no return

The fossil projects that would cause lock-in to over 2°C warming



The key to avoiding climate chaos is to act immediately to reduce emissions in this decade. Climate scientists calculate that the carbon that has already accumulated in the atmosphere will likely increase the average temperature by another 0.8ºC. Therefore, the room to manoeuvre to reduce emissions is getting smaller all the time, given the continued ineffective action of governments.

The IEA has said more than once that there is little room for manoeuvre. In November 2012, when it released its annual World Energy Outlook, IEA chief economist Fatih Birol said: "The chances are slimmer and slimmer of avoiding a 2°C rise."[43] The IEA also said that CO_2 emissions related to energy production are expected to increase from "an estimated 31.2Gt in 2011 to 37.0Gt in 2035, pointing to a long-term average temperature increase of 3.6°C."[44]

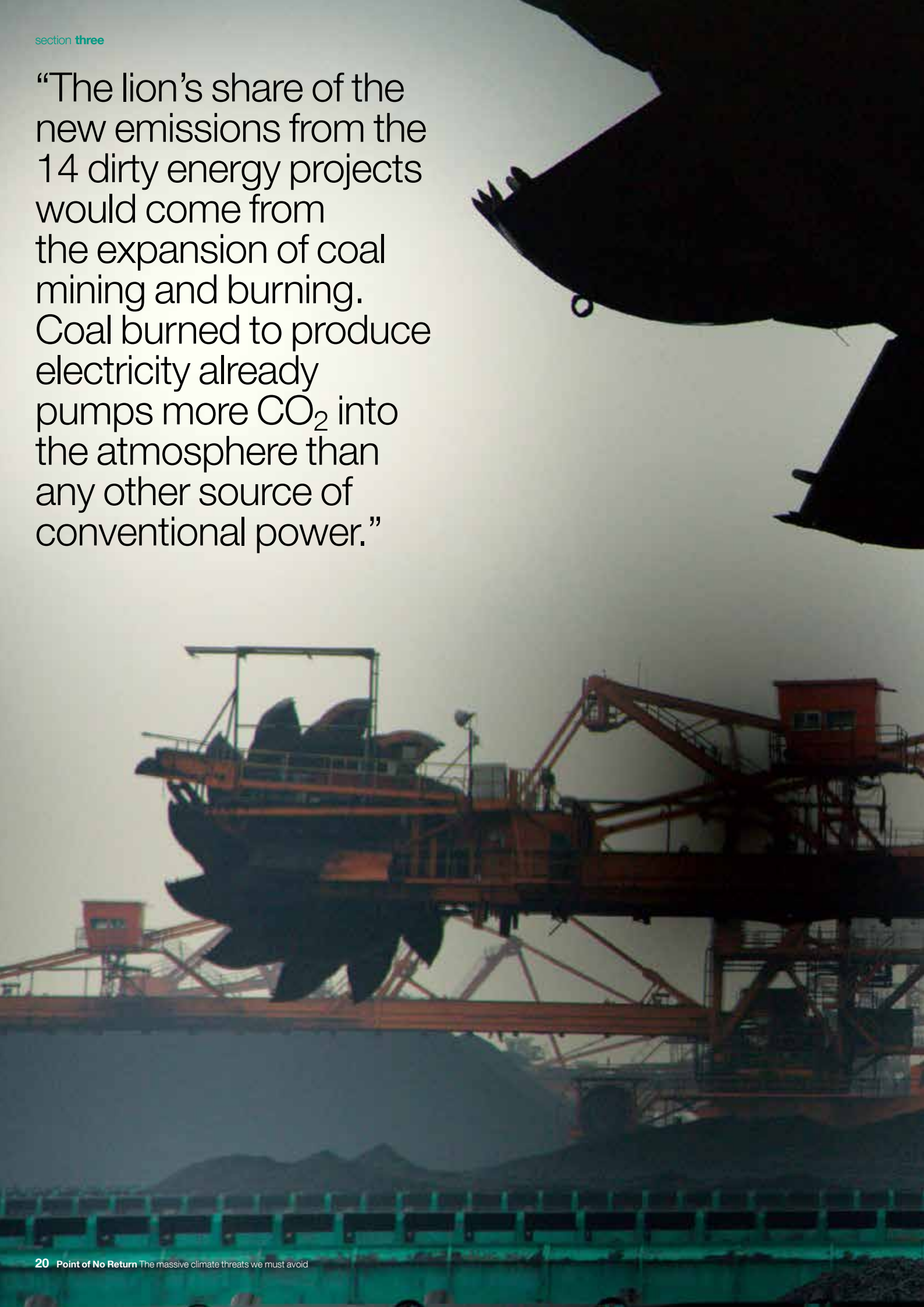
The 75% scenario developed by Ecofys shows that emissions must peak in 2015 and then decline by 5% a year to get cumulative emissions down to 1,500Gt, the combination of historic emissions of 450Gt CO_2e and the Ecofys carbon budget of 1,050. That of course means not adding the 300Gt of new emissions the 14 projects would create by 2050.

The world should be – but is clearly not – on a path to lower emissions already. Almost 200 nations agreed in 2010 to limit the global average temperature rise to below 2ºC, to avoid the most devastating impacts from climate change.[45] The new coal, oil and gas projects featured in this report will make cutting emissions even more difficult.

The lion's share of the new emissions from the 14 dirty energy projects would come from the expansion of coal mining and burning. Coal burned to produce electricity already pumps more CO_2 into the atmosphere than any other source of conventional power. Coal-fired power plants are responsible for three-quarters of "locked in" emissions in the power sector.[46] By 2020, the dirty projects would extract an additional 1,400 million tonnes of coal, enough to fuel 550 large coal-fired power stations.[47] The growth in coal use is the sole reason CO_2 emissions grew at record rates over the past two years.[48] Coal burning also produces pollutants and toxic emissions that cause hundreds of thousands of deaths a year.[49]

The other major source of new emissions from the 14 projects would be oil. The world already consumes 77 million barrels of oil a day (mbd), 54% of which is used by transport.[50] The new oil projects in this report would add an additional 13.6mbd of oil production by 2020, with annual CO_2 emissions by then of 2,200 million tonnes.[51] This would be equivalent to putting an extra 500 million cars on the road[52], an additional dose in the prescription for disaster we have now.

"The lion's share of the new emissions from the 14 dirty energy projects would come from the expansion of coal mining and burning. Coal burned to produce electricity already pumps more CO_2 into the atmosphere than any other source of conventional power."



The methodology of the Ecofys report

The methodology Ecofys used for its analysis included:

- developing fuel production information for the project inventory based on government sources, corporate sources, including Petrobrás, the state-owned Brazilian fossil fuel company, and the consulting firm Wood MacKenzie, and on publications from the IEA, the US Geological Survey and Geoscience Australia;
- estimating the expected fuel production from the 14 sources to 2050;
- using CO_2 emission factors from the IPCC, and energy conversion factors from the National Institute of Standards and Technology, the IEA and the American Physical Society, to calculate the annual emissions from the 14 projects and their total emissions from 2012 to 2050; and
- estimating the CO_2 emissions associated with the production (as opposed to combustion) of the dirty fuels. For most of the projects, these emissions were estimated at 15% of combustion emissions, while for the tar sands, conventional gas and shale gas emission factors from literature were used.

Ecofys considered:

- all tar sands production in Alberta, Canada, and in the Orinoco region of Venezuela, to be additional to current production because it is unconventional;
- all oil and gas that may be produced in the Arctic, all oil from off shore Brazil and all oil from the Gulf of Mexico as additional;
- coal from production expansion in China, Australia, Indonesia, and the northwest US as additional;
- oil and natural gas from the Caspian Sea as additional because both are to grow strongly over the next few decades; and
- gas from Africa and oil from Iraq as additional because both are expected to grow substantially.

Image Volunteers distribute donated food and supplies at a makeshift base to help residents of Queens, New York City, still without power after Hurricane Sandy.


© MICHAEL NAGLE / GREENPEACE

#4

Overshooting 2°C: A world we don't want

New evidence is emerging of just how deadly and expensive overshooting 2ºC could be for the planet. The impacts from the current level of warming are already severe enough to frequently cause great human tragedy.

The massive storm named Hurricane Sandy, which hit the eastern coast of the US in October 2012, is one consequence of climate change. Approximately 200 people died in the US and in the Caribbean, where Sandy also struck.[53] Millions of people were affected. 300,000 houses were destroyed in New York State alone,[54] businesses and jobs were disrupted, and electricity was cut for days. The states of New York and New Jersey alone expect the costs of Sandy to total $62bn US dollars.[55]

In addition, scientists now agree that recent catastrophic weather events – such as the heat waves in Europe in 2003 that killed 70,000[56] and the droughts in the US state of Texas in 2011 that caused $5bn in damage – are a consequence of human-induced climate change.[57] The 2012 US drought resulted in a significant reduction in the corn crop, which will cause food prices to rise[58] – an increasingly common consequence of climate change. Extreme weather events will only become more frequent and more severe as temperatures continue to rise.[59]

With the average global temperature already about 0.8ºC above pre-industrial times, a report by the humanitarian organisation DARA has calculated that 5 million deaths a year are now caused by air pollution, hunger and disease, as a result of climate change and carbon-based economies.[60] This in a world where the temperature increase has not hit even 1ºC, let alone 2ºC or more.

The world's poorest nations are the most vulnerable, facing increased risk of drought, water shortages, crop failure, poverty and disease. The DARA report estimates that current climate impacts cost the world $80bn in 2010, when climate-induced natural disasters, labour productivity losses, health impacts, and losses to industries such as agriculture, are considered.[61]

Bangladesh's Prime Minister Sheikh Hasina said: "One degree Celsius rise in temperature is associated with 10% productivity loss in farming. For us, it means losing about 4 million metric tonnes of food grain, amounting to about $2.5bn, that is about 2% of our GDP."[62]

Spikes in food prices will get worse and more frequent as extreme weather events caused by climate change devastate food production.[63] Droughts in the US Midwest and Russia in 2012 helped to push prices for maize and soyabeans to record highs.[64] The UN's food agencies have urged world leaders to take swift action to ensure that food-price shocks do not turn into a catastrophe that could hurt tens of millions of people.[65] The agencies said the 2007/08 price spike contributed to an 8% rise in the number of undernourished people in Africa.[66]

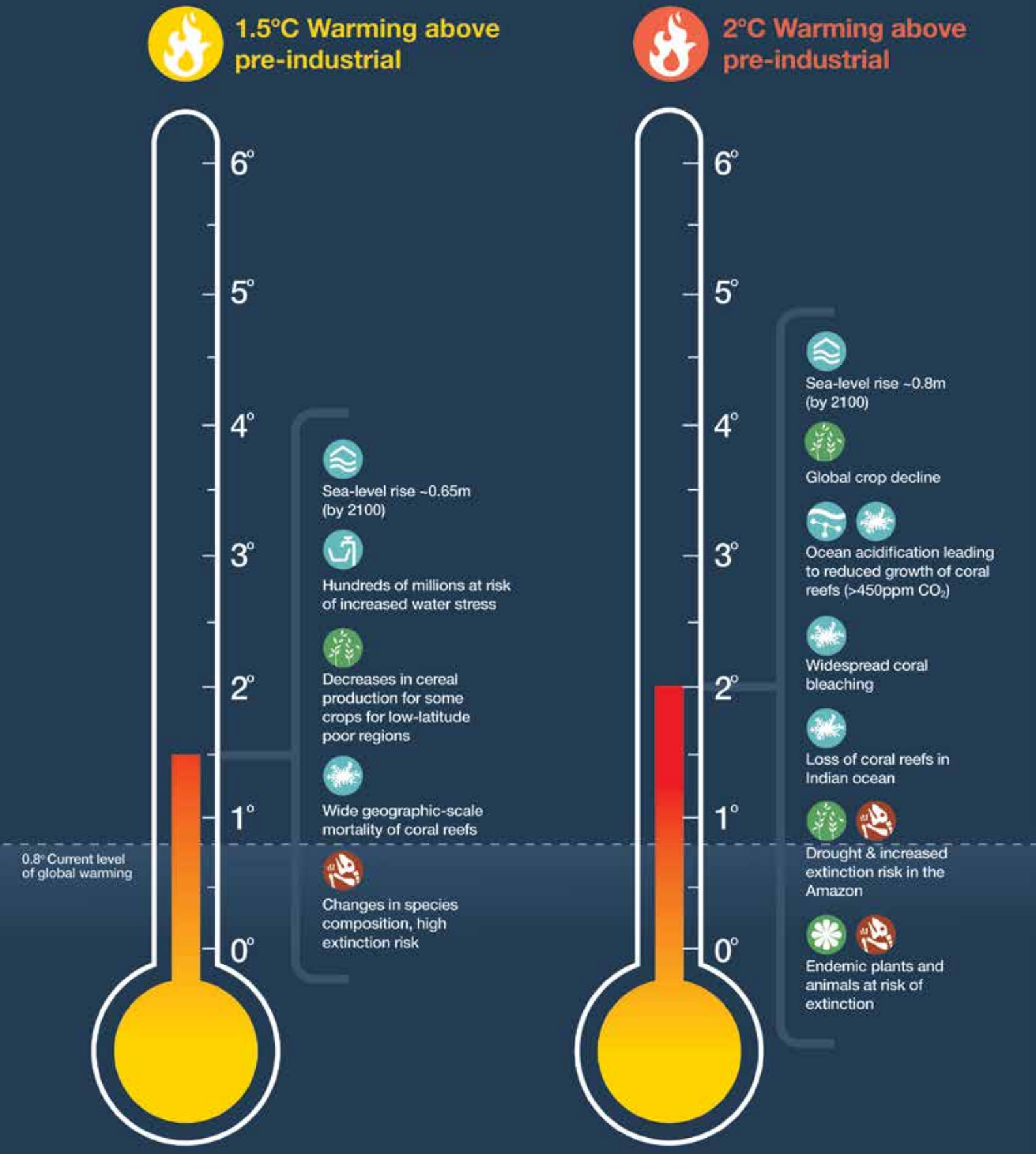
If the 2°C target is surpassed, the impacts already being experienced will be much worse, and some new impacts will occur. A large-scale rise in sea levels is likely to be triggered somewhere between a 1.8ºC and 2.8ºC increase. This would threaten the existence of lower-lying islands. Beyond 3.5ºC, the sea-level rise would be up to two metres, a height that would threaten many more coastal villages, towns, and cities. Most corals will bleach, and widespread coral mortality is expected if the temperature rise goes to 3°C above the temperatures recorded in the late 19th century. Up to 30% of global species will be at risk of extinction, and the figure could exceed 40% if the increase surpasses 4°C.[67]

Warming of over 4°C would be catastrophic, as various tipping points are expected to be triggered at this level. For example, if the Amazon dries, it will release further CO_2.[68] Rising Arctic temperatures will also lead to CO_2 and methane being released through the permafrost thawing, with the potential to eat up more than 10% of the remaining carbon budget.[69] Climate change would most likely become impossible to stop, and large parts of the planet would become uninhabitable.

These potential impacts from failing to act on climate change show just how important it is to step back from the point of no return.

Climate change impacts

The impacts of various levels of global warming



Source: Ecofys, Climate Analytics & Potsdam Institute for Climate Impact Research 2011: *A snapshot of a warming world.* http://climateactiontracker.org/assets/CAT-infographic-20111211.pdf

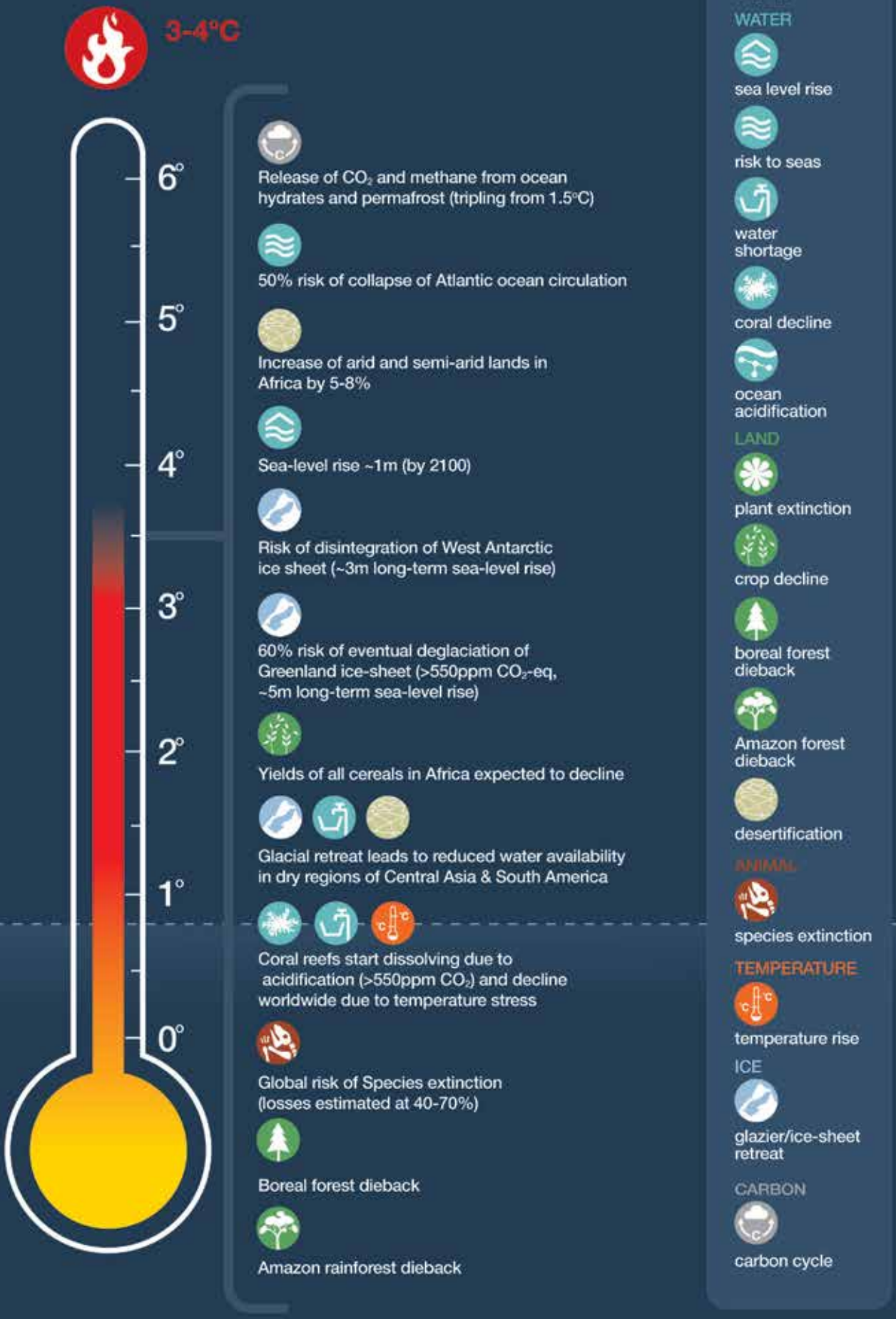

3-4°C
6°
5°
4°
3°
2°
1°
0°
Release of CO_2 and methane from ocean hydrates and permafrost (tripling from 1.5°C)
50% risk of collapse of Atlantic ocean circulation
Increase of arid and semi-arid lands in Africa by 5-8%
Sea-level rise ~1m (by 2100)
Risk of disintegration of West Antarctic ice sheet (~3m long-term sea-level rise)
60% risk of eventual deglaciation of Greenland ice-sheet (>550ppm CO_2-eq, ~5m long-term sea-level rise)
Yields of all cereals in Africa expected to decline
Glacial retreat leads to reduced water availability in dry regions of Central Asia & South America
Coral reefs start dissolving due to acidification (>550ppm CO_2) and decline worldwide due to temperature stress
Global risk of Species extinction (losses estimated at 40-70%)
Boreal forest dieback
Amazon rainforest dieback
KEY
WATER
sea level rise
risk to seas
water shortage
coral decline
ocean acidification
LAND
plant extinction
crop decline
boreal forest dieback
Amazon forest dieback
desertification
ANIMAL
species extinction
TEMPERATURE
temperature rise
ICE
glazier/ice-sheet retreat
CARBON
carbon cycle

Image Wind Farm Forest Creek in Big Spring, Texas, producing 2.3MW with wind turbines made by Siemens.

#5

Clean solutions for the power sector

Environment and communities do not need to be put at risk for the sake of extracting more coal to produce electricity. Governments have a choice. They could continue to support the planned expansion of the US, Australian, Indonesian and Chinese coal operations, which would pump an additional 3 billion tonnes of carbon pollution into the atmosphere every year, leading to untold environmental consequences.[70] Or, governments could turn away from using coal for electricity production and champion renewable energy.

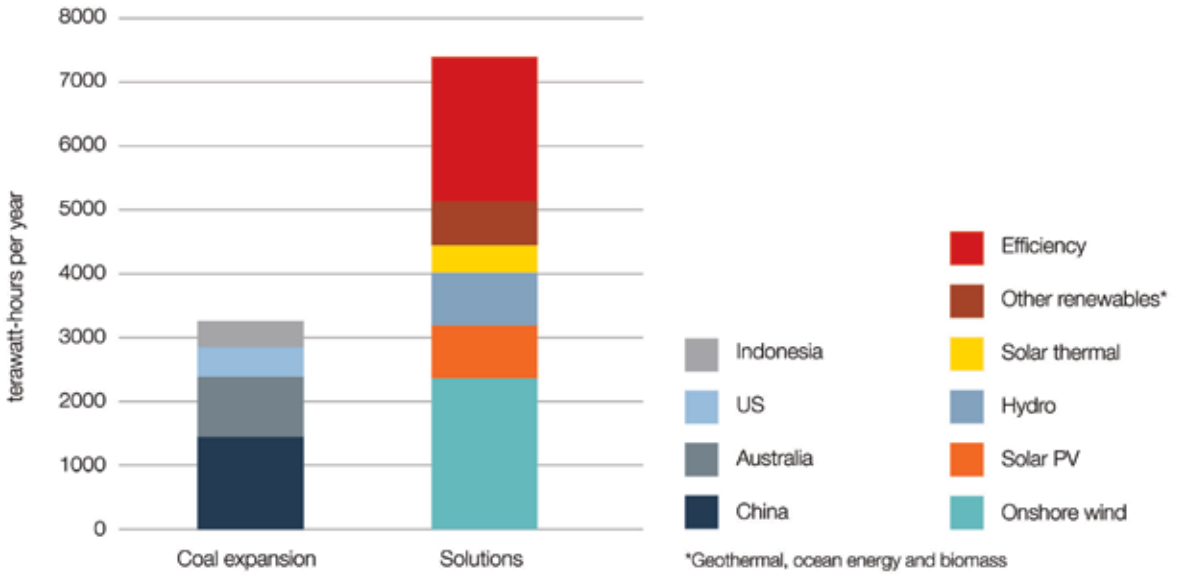
Greenpeace had developed a global Energy [R]evolution scenario that shows how to make the transition from dirty coal to renewable power by using existing renewable energy technologies and by increasing energy efficiency. If the current rate of growth in the renewable energy sector is maintained, wind and solar energy would overtake coal in electricity production in less than 15 years. The Energy [R]evolution scenario shows how coal-fired power generation could be eliminated as existing facilities retire, and how the world's power needs could be met with clean energy without building new coal plants.[71]

The global Energy [R]evolution scenario shows that a range of already existing technologies – from solar to wind, ocean and geothermal – could replace electricity generation from coal, based on what suits a local situation. For example, Spain, with its abundance of sun, has become a leader in concentrated solar thermal power, while Denmark with its windy coastline makes investment in offshore wind plants its priority. Electricity would also be generated locally – creating local jobs – without the need to rely on outdated national infrastructure that is costly to maintain. Renewable energy – if subject to the right development conditions, and if unfair barriers such as fossil fuel subsidies are removed – has the potential to be a massive global employer. The Energy [R]evolution shows renewable energy could employ up to 8 million people by 2020, compared to the coal industry's 2.8 million.[72]

A key part of doing away with dirty fossil fuels is to ensure energy is used more efficiently. This will result in better products that waste less energy and that reduce energy costs to consumers. Implementing a strict technical standard to ensure all electrical appliances are designed to be as energy efficient as possible would mean it would be possible to switch off more than 340 coal-fired power plants in OECD countries, removing 2,000Mt of CO_2. Efficient lighting alone could close 80 coal-fired power plants,[73] reducing CO_2 emissions by 500Mt. Even bigger gains in demand reduction could be realised if entire systems – such as houses and cars – were rethought and made more efficient.

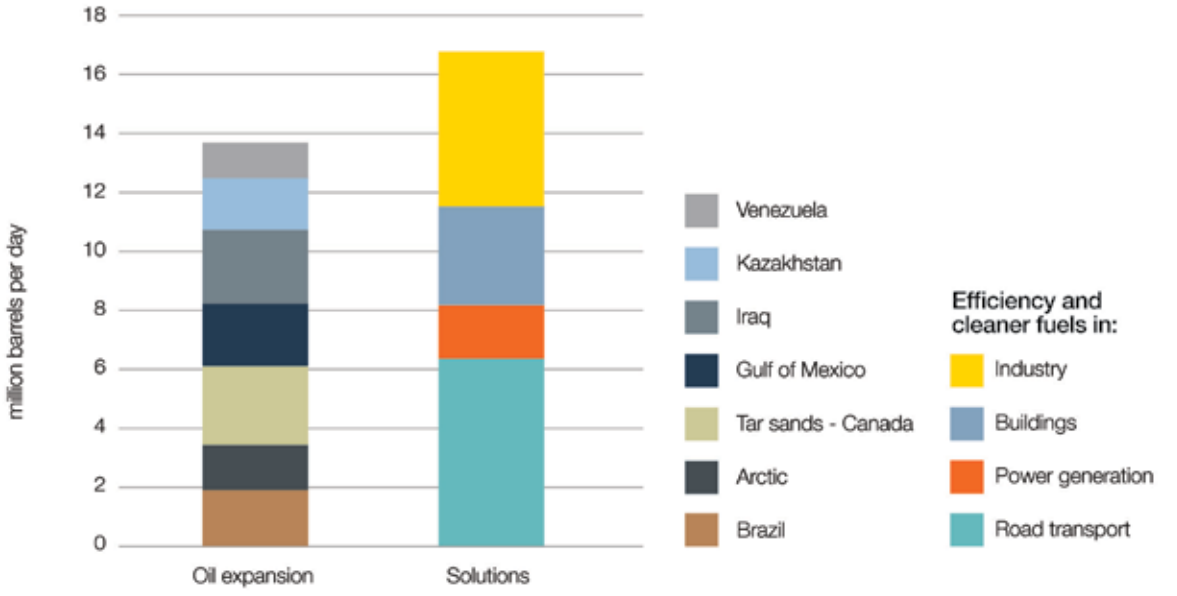
Dirty vs. Clean energy

Solutions for Coal: Realistic deployment by 2020



Source: Greenpeace 2012: *Energy Revolution: A Sustainable World Energy Outlook*

Solutions for Oil: Realistic deployment by 2020



Source: Greenpeace 2012: *Energy Revolution: A Sustainable World Energy Outlook*

Image Hellisheiði Geothermal Plant is situated at Hengill, an active volcanic ridge in SW Iceland. The Hellisheiði Power Station is the second largest geothermal power station in the world, and the largest in Iceland. The plant's purpose is to meet increasing demand for electricity and hot water for space heating in the industrial and domestic sectors. Estimated capacity for the completed Hellisheiði Plant is 300MW electricity and 400MW thermal energy. Once this capacity is reached, it will rank as the largest geothermal power station in the world in terms of installed capacity.

Transitioning to renewable power generation would also save more money than retaining conventional electricity sources. The reference scenario in the Energy [R]evolution shows the impact of continued reliance on dirty energy sources would be $1.3 trillion more a year – almost $200 per person globally – spent on coal, oil and gas, than the no-fuel-cost pathway of the Energy [R]evolution. Overall, thanks to better energy efficiency and lower fuel costs, less money would be spent on power generation on the renewable energy pathway than on the dirty energy pathway.[74]

An impressive roll out of renewable technology is already occurring. Renewable energy is now providing more than 30% of new electricity production globally.[75] By 2035 renewable energy could be increased to 65% of electricity production, and energy efficiency could be significantly increased, according to the Energy [R]evolution, to avoid the catastrophe of passing the point of no return. Clearly, renewable energy could turn the tide against coal. The world does not need the coal reserves in the US, China, Indonesia and Australia to be dug up and burned. Alternatives exist, and are being used right now.

No need for deadly fuel when clean options abound

About 54% of the 77 million of barrels of oil burned each day is used for transportation, in cars, trains, planes and ships.[76] The remaining barrels are used to provide heat for buildings and industrial processes as well as to generate some electricity.

If the fossil fuel industry is allowed to drill as much as it wants in waters off Brazil and in the Arctic, and to mine Canada's tar sands, it could produce 10 million barrels of oil a day from these sources alone. That's enough to fill 4,000 huge oil tankers[77] a year.

But governments don't need to push the climate to the point of no return and risk these pristine environments to appease the global addiction to oil. By implementing simple policies, such as upgraded fuel economy standards or transitioning to alternative technologies such as electric cars and renewable sources of power and heating, dramatic cuts can be made in demand for oil by more than the dirty oil projects would produce.

The Energy [R]evolution scenario shows that – through a combination of ambitious efforts to introduce higher-efficiency technologies for vehicles, a major switch to electric vehicles and incentives for travellers to save CO_2 – it would be possible to reduce transport emissions by 40% in 2050, compared to 2007 levels.[78]

In the US, fuel economy standards introduced in the 1970s to ensure new cars used less fuel are already saving approximately 2.8 million barrels a day, almost equal to the targeted oil production in the Arctic.[79] Updating this policy to reflect advances in technology and rolling it out globally could save 15 million barrels, not to mention the millions that car owners would save when filling their tanks.

Advances are being made in batteries for electric cars all the time. A 2010 Deloitte report estimated that by 2020 electric and other "green" cars will account for one third of total global car sales,[80] while Nissan CEO Carlos Ghosn predicts that one in ten cars globally will run on battery power alone by 2020.[81] Nissan has sold 27,000 all-electric model Leaf cars since its introduction in 2010, with forecasts for sales of 1.5 million zero-emission cars by 2016.[82] Governments around the world are also beginning to support the electric-car industry with the US pledging $2.4bn US dollars in federal grants for electric cars and batteries. China has provided $15bn to kickstart its electric car industry, with further subsidies for transition technology.[83] If just 10% of driving were done in electric vehicles, more than 2 million barrels of oil would be saved every day.

Image A coal train near the town of Blackwater, Australia.

Greenpeace's Energy [R]evolution scenario has shown how demand for oil could be reduced in other transport sectors. Truck and ship freight could use less oil by improving their load handling to maximise the space available.[84] Increasing electric train use would also help, as trains are the most efficient form of transport. New technology would also dramatically help improve transport efficiency. For example, a 65% reduction in fuel use is possible in new aircraft by 2050.[85] Further policy measures that would encourage a reduction in passenger transport demand include incentives for working from home, stimulating the use of video conferencing in businesses and improved cycle paths in cities.

The remaining oil currently used in temperature control of buildings and in industry could also be replaced with cleaner fuels, including renewable electricity, sustainable plant-based bio oils, solar heating and district heating and cooling. Demand can be reduced through the implementation of smarter technology and energy efficiency policies.

For example, new buildings could be built to require minimal energy for heating and cooling, as is the case in tens of thousands of buildings in Germany and elsewhere in Europe. Or, buildings undergoing major renovation could be required to use renewable energy to provide a certain proportion of their heating and cooling, as is already in place in Australia and some other countries. Governments should also promote combined heat and power (CHP), which uses the heat generated during production and manufacturing that would normally be wasted and turns it into a source of energy that can heat buildings and water in the surrounding area.

Adopting policies to support energy-saving technology such as CHP, low-energy houses, as well as using cleaner fuels and renewable energy, would save another 9 million barrels of oil a day, making the assured destruction of environments such as the Arctic, Brazil's coastline and Canada's Boreal Forests completely unnecessary.

Image The Chicheng Wind Farm in Hebei Province, China, an area rich in wind energy resources.

© SIMON LIM / GREENPEACE

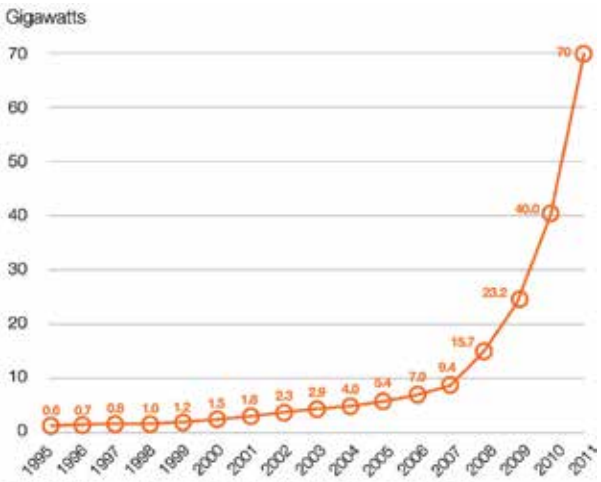
#6

The vision of the Energy [R]evolution can achieve results

Since 2007, Greenpeace has produced scientific modelling that identifies a sustainable path for the world to quit dirty, dangerous fossil fuels through a transition to renewable energy, and by using that energy more efficiently. The Energy [R]evolution scenario shows how governments and industry could achieve more power and mobility for less money, without damage to the environment and communities. More jobs, fairer and secure access to energy, and better standards of living mean that there are substantial benefits for not only the environment and the climate, but also for the economy and society.

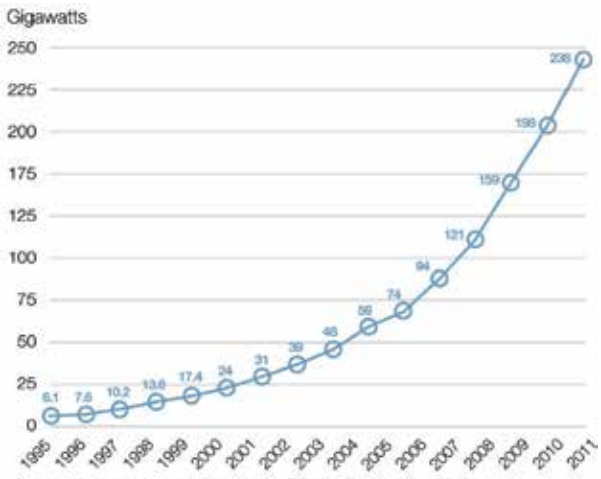
The speed with which renewable energy has been rolled out around the world by governments, companies and communities has meant that what started as a dream of a clean energy future is starting to become a reality. It's only through stepping up this revolution in clean energy that we can avoid the worst of the climate crisis.

Solar PV: total world capacity 1995-2011



Source: Renewables capacity graphs: REN21: Renewables 2012. Global Status Report. http://new.ren21.net/Portals/0/documents/activities/gsr/GSR2012_low%20res_FINAL.pdf

Wind power: total world capacity 1995-2011



Source: Renewables capacity graphs: REN21: Renewables 2012. Global Status Report. http://new.ren21.net/Portals/0/documents/activities/gsr/GSR2012_low%20res_FINAL.pdf

The Energy [R]evolution

Following Greenpeace's Energy [R]evolution would achieve the following:

A PEAK IN CARBON EMISSIONS from the ENERGY +TRANSPORT SECTORS IN THE NEXT FEW YEARS, AND AN

85%

---CUT BY 2050[86]

$1.3 trillion

US dollars in fuel cost savings a year

By investing $1.2 trillion in new power plants every year until 2050. The switch to renewable power will pay for itself in the long run. The savings would be made because once the infrastructure was built there would be

NO COST

TO HARNESS RENEWABLE ENERGY UNLIKE WITH CONVENTIONAL FOSSIL FUELS[89]

LOWER ENERGY DEMAND IN THE TRANSPORT SECTOR THANKS TO A SHIFT TO SMALLER, ELECTRIC CARS AND THE USE OF MORE EFFICIENT MASS-TRANSIT METHODS, SUCH AS ELECTRIFIED TRAINS

IN 2030 ELECTRICITY WOULD PROVIDE **12%** OF THE TRANSPORT SECTOR'S TOTAL ENERGY DEMAND

44%

IN 2050[88]

37%

OF ELECTRICITY FROM

RENEWABLES BY 2020

94%

OF ELECTRICITY FROM

RENEWABLES BY 2050

WHEN A MASSIVE 15,100GW WOULD BE INSTALLED, MOSTLY IN THE FORM OF

GEOTHERMAL **WIND**

SOLAR PHOTOVOLTAIC

TECHNOLOGIES[87]

MORE JOBS

22.6 MILLION

ENERGY SECTOR JOBS BY 2020

ONLY 17.8 MILLION

IN THE BUSINESS-AS-USUAL SCENARIO[90]

Image Greenpeace activists protest at Shell drillship *Noble Discoverer,* anchored near Dutch Harbor in Unalaska. Greenpeace is campaigning to save the Arctic from attempts by oil companies to exploit the region's resources for short-term profit.

© JIRI REZAC / GREENPEACE

#7

Action!

This report marks the beginning of a sustained, global Greenpeace campaign to stop the dirtiest coal and oil-extraction projects featured here, and replace them with the available sustainable energy solutions. This campaign mirrors and supports existing community opposition to many of these projects. Greenpeace will continue to expose companies such as Shell and other fossil fuel corporations who pose direct threats to the environment and communities.

Community opposition is growing

Around the world, individuals and communities are joining together to oppose these projects. From openly calling for sit-ins and getting arrested (Keystone XL movement, Canada and the US), to denying fossil fuel companies access to land (Lock the Gate, Australia), and to tackling coal-mine expansion in China with science, strong local alliances have formed, and they are making inroads against the lobbying and spin pedalled by the fossil fuel industry.

How action is being taken!

© GREENPEACE / KARUNA ANG

Image Activists wave signs during a rally against the Keystone XL tar sands pipeline, outside the Ronald Reagan Building where the final public hearing by the US Department of State is taking place.

Keystone XL movement

www.tarsandsaction.org

One of the grassroots climate movement's biggest successes in recent history occurred early in 2012 when US President Barack Obama knocked back permission until after the 2012 election for a 2,736km oil pipeline that would run from the tar sands of Alberta, Canada, to refineries on the US coast of the Gulf of Mexico. But now, the pressure is on the President to deliver his final verdict.[91] Record numbers of Americans and a large number of Canadians opposed the pipeline even as Big Oil threatened the Obama Administration with "huge political consequences" for standing in its way. The campaign brought together the grassroots climate movement, NGOs, indigenous groups, farmers and ranchers, Canadians and Americans. The campaign quickly moved beyond political lobbying and online petitions, openly calling for people to get arrested to show their conviction. Over 1,200 people were arrested at sit-ins in front of the White House, with over a hundred more arrested at a sit-in in front of the Canadian Parliament. These sit-ins generated nationwide protests that placed the requisite pressure on the Obama Administration.

Power Past Coal

www.powerpastcoal.org

Power Past Coal is an ever-growing alliance of health, environmental, clean energy, faith, and community groups that are working together to stop coal exports through ports on the US West Coast. The movement – concerned about the health and environmental impacts of hundreds of coal trains rumbling through their communities, which includes the Columbia River Scenic Area – has the ear of Oregon governor John Kitzhaber, who has called for an environmental-impact review of the coal-transport plans. Thousands of local residents have joined with over 170 elected officials, and hundreds of businesses, faith leaders, and physicians, to express their concern or opposition to coal-export proposals. The coalition has been tirelessly working to raise awareness of the issue throughout the region and to ensure that public officials are protecting local communities, not coal industry profits, with local nodes organising local events on local issues. Robert F Kennedy Jr recently spoke at their rally in Portland, Oregon.

© STEVE DIPAOLA / GREENPEACE

Image Signs spell out "Stop Coal" in Portland's Pioneer Square to show opposition to shipping dirty coal, for export to Asia, on trains and barges through Portland and other northwest communities.

Lock the Gate and Save the Reef

www.lockthegate.org.au
www.savethereef.org.au

Concerned that the health and the environment of communities near coal and gas mining across Australia have been ignored in the interests of energy-resource mining that is supported by morally and ethically absent governments, a mega-alliance of 114 community groups was formed under the Lock the Gate banner. There is a growing perception of political and regulatory failure to protect people, land, bush and water from coal and gas in Australia. Lock the Gate is the embodiment of a popular backlash against that failure. The signature tactic of the group is landholder and community blockades to deny access to fossil-fuel companies. Greenpeace Australia is working in conjunction with local communities to prevent the construction of major new coal terminals on the Great Barrier Reef coast.

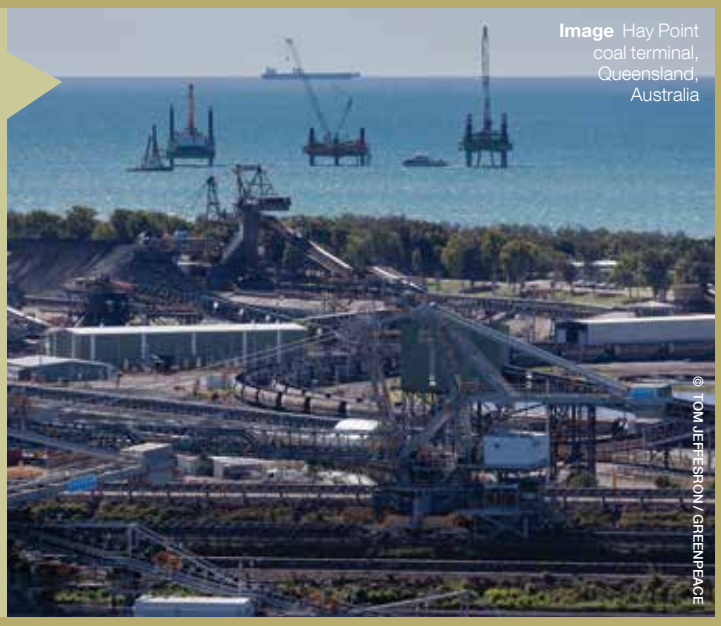


Image Hay Point coal terminal, Queensland, Australia

© TOM JEFFERSON / GREENPEACE

© JOERG MODROW / GREENPEACE

image Greenpeace activists protest against the Finnish icebreaker *Nordica* in the Baltic Sea in order to prevent it from heading to Shell's Arctic oil drilling project in the north of Alaska.

Direct action against Shell's Arctic oil drilling

www.savethearctic.org

Greenpeace has embarked on a major campaign to oppose Shell's plans to drill for oil in the Arctic. More than 50 activists took direct action in the first half of 2012 by boarding the Anglo-Dutch giant's icebreakers and oil-drilling ships in the seas off New Zealand, Sweden and Germany, while thousands more volunteers have voiced their own message to Shell, the first major international oil company to make exploitation of the Arctic a major focus. If Shell strikes oil, other global oil giants could quickly follow and spark an Arctic oil rush, threatening the pristine environment and the species and communities who call it home. The actions have galvanised public opposition to the threat to the Arctic, and 2.3 million people have now joined the campaign to declare the Arctic off limits to oil drilling and destructive industry.

Tackling coal mining expansion in China with science

www.greenpeace.org/china/zh or
www.greenpeace.org/eastasia

Greenpeace East Asia is working with Chinese academics to publish research that shows the economic, environmental and social benefits of investing heavily in renewable energy and energy efficiency instead of in coal. Greenpeace also investigates and documents the multiple impacts that coal has on society, from climate change to air and water pollution to health damage. Recent reports showed coal is responsible for 500,000 premature deaths in China every year,[92] and that the sandstorms which plague the country also disperse coal ash – containing toxic arsenic, selenium and lead – from the western mining provinces across Beijing, Shanghai and Hong Kong. Greenpeace East Asia has said the Chinese government must quit coal if it is to realise its renewable energy and climate goals in its 12th Five Year Plan. The campaign encourages citizens of Hong Kong and mainland China to take personal action and support government action on climate change.

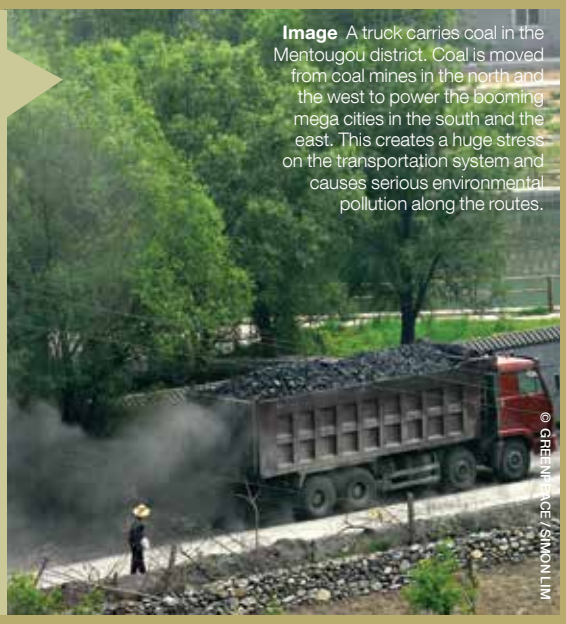


Image A truck carries coal in the Mentougou district. Coal is moved from coal mines in the north and the west to power the booming mega cities in the south and the east. This creates a huge stress on the transportation system and causes serious environmental pollution along the routes.

© GREENPEACE / SIMON LIM

Appendix

This section describes selected projects in depth, detailing the expected level of production for the coal, oil and gas projects, details of emission levels, and the severe environmental harm these projects will cause. Some of the world's most iconic ecosystems are at risk from these projects, including the Great Barrier Reef off Australia, the fragile Arctic, the Yellow River of China, the Great Bear Rainforest on the west coast of Canada, habitat and mating grounds for whales off the coast of Brazil and the tropical rainforest of Indonesia.

Additional CO_2 emissions from the dirty energy projects by 2020 and 2035, million tonnes a year

	2020	2035
Coal expansion in China's Western provinces	1380	1380
Coal in Australia (aggregated)	759	1181
Artic drilling for oil and gas	519	1167
Coal in Indonesia	458	458
Tar sands in Canada	424	706
Coal in the US	422	422
Iraqi oil	417	814
Gulf of Mexico deepwater oil drilling	349	349
Deepwater oil drilling (pre-salt) Brazil	328	660
Caspian oil production (Kazakhstan)	286	382
Unconventional gas in the US	282	810
African gas production	261	586
Caspian gas production (Turkmenistan, Azerbaijan and Kazakhstan)	241	360
Orinoco tar sands (Venezuela)	191	361

Tens of thousands of coal ships threaten the Great Barrier Reef

Key facts: Increase in annual CO_2 by 2020: 760Mt

Country with comparable annual emissions: Germany

Companies involved: In the Bowen Basin, Hunter Valley, Gunnedah Basin and Surat Basin: Xstrata, BHP Billion, Peabody, Anglo American, Rio Tinto, Vale, Yancoal.

In the Galilee Basin: Waratah Coal, Vale, Macmines Austasia, Adani and GVK.

Australia's mining industry has a dirty plan to more than double its coal exports in a little over a decade – a move that would add an extra 900 million tonnes (Mt) of CO_2 a year to the atmosphere. In total, if Australian coal exports increase by the volume estimated by the Australian Bureau of Resource and Energy Economics, Australian export coal could be responsible in 2025 for 1,200Mt of carbon dioxide pollution annually.[93]

Australia is already the world's biggest coal exporter, and the second biggest exporter of thermal coal. The industry has been expanding in the states of New South Wales and Queensland, and further expansion plans are in the pipeline. These include plans to build up to nine new coal ports and terminals along the coast of the Great Barrier Reef World Heritage Area.[94] The Reef is under particular threat from coastal development and climate change – and the coal industry is a key driver of both.

The Great Barrier Reef Marine Park Authority and the Monitoring Mission of UN's Educational, Scientific and Cultural Organisation's (UNESCO),[95] which visited the Reef in 2012, have both said that decisions made in the next few years will determine its future.

New and expanded mines are eating away at farmland and putting water supplies at risk in the Hunter Valley, Liverpool Plains and Darling Downs. An entirely new region for mining, the Galilee Basin in Queensland, is proposed for exploitation to a scale of coal mining unprecedented in Australia. The Galilee Basin has long been too remote to make it economical for the mining industry. But with development in China and India generating a boom in coal prices, companies such as Hancock Coal (GVK), Waratah and Adani are proposing to build a series of mega mines that will cut the heart of central western Queensland open. For their plans to make financial sense, they want to build integrated mines, railways and ports to allow them to export their dirty product. The Australian government's estimate of coal export infrastructure needs to 2020 and 2025 includes only five of the nine mega mines proposed for the Galilee Basin. A Greenpeace investigation into the extent of mining proposed for this region found that, at full production, the nine mines currently proposed for the Galilee would together produce 330 million tonnes of coal.[96] That much coal would fill a train long enough to wrap around the world one and half times.[97]

Mega mines mean mega emissions

Two of the mines slated for the Galilee Basin are expected to produce a total of more than 120 million tons of coal a year.[98] To put this into perspective, the largest mine currently operating in Australia produces roughly 30 million tons a year. Australia has recommitted to its promise to be part of a global effort to limit global warming to below 2ºC. The expansion of the coal-export industry is not compatible with the government's commitment. The IEA, in its *World Energy Outlook 2011,* developed a scenario that estimates world energy consumption to 2035 that would be compatible with meeting the 2°C limit with global demand for coal peaking around 2016 and then declining by 2.7% a year on average.[99]

The global picture

Burning Australian coal does not just affect Australia's contribution to global emissions since the emissions are "exported" to the countries using the coal. The impacts will be on the quality of life of the people living where the coal ends up getting burned. In India and China, two countries seen as the most likely potential customers for the coal, urban air pollution is already among the worst in the world.[100] Delhi's air had over four times more particulate pollution in 2010 than recommended in the country's air quality standard.[101] Coal-fired power stations are one of the largest sources of the pollution plaguing people in Delhi. The Organisation for Economic Co-operation and Development (OECD) estimates that air pollution causes 270,000 premature deaths a year in India. In China – also seen as a guaranteed buyer – the death total is 600,000.[102]

Great Barrier Reef to become a coal super-highway

To get the newly-mined coal out of Australia, the coal industry proposes several large new coal terminals and ports along the coastline of the Great Barrier Reef World Heritage Area. The bulk carriers to export the additional coal would travel through the Great Barrier Reef.[103] If all proposed new ports and terminals were to go ahead as planned, around 11,000 ships a year would cut through the Great Barrier Reef, seriously threatening marine biodiversity.[104]

A coal accident recently affected the Reef. In 2010, a coal ship ran aground on the Reef, leaving a 3km scar across the coral,[105] where toxic paint has persisted in the environment. More ships mean more pollution, more risk of spills, groundings and collisions. The threat to the Reef from coastal industrialisation is so grave that UNESCO has been forced to speak out, warning the Australian government that if the coal mining projects go ahead, it would be forced to place the reef on the list of "in danger" sites. In June 2012, the World Heritage Committee passed a decision requesting that Australia "ensure that development is not permitted if it would impact individually or cumulatively on the Outstanding Universal Value of the property".[106] Following that warning, the government indicated it would revisit the approval for one of the mega mines.

Dredging an icon

One area particularly targeted for new coal-port development is Abbot Point, where four new coal terminals are proposed. For coal ships to be able to access three of these new coal terminals, three million cubic metres of sea floor would need to be dredged from the Great Barrier Reef World Heritage Area.[107] Dredging would destroy vital marine habitat, including seagrass meadows, which are feeding habitat for dugongs and green turtles. Green turtles currently use a beach next to Abbot Point for nesting, and both Abbot Point and Hay Point have been described as important mainland nesting habitat for flatback turtles in north Queensland.[108] Expanding the capacity of the ports would mean more light and noise pollution, more ships, and would inevitably degrade the "Outstanding Universal Value" of the Great Barrier Reef identified by UNESCO. Furthermore, marine mammals, including humpback whales, dugongs and dolphins, are sensitive to noise: construction of the "T3" coal terminal at Abbot Point would require 15 months of continual underwater pile-driving, including during the mating, nesting and calving seasons for some of these animals.[109]

The Great Barrier Reef took millions of years to form, but there is a risk it would be wiped out altogether if the impacts from global warming are not controlled. Burning coal is a major cause of climate change, which may push the Great Barrier Reef to extinction thanks to coral bleaching and ocean acidification. According to a Report Card on Australia's oceans released in August 2012, warming temperatures have already affected the growth of baby seabirds, changed the sex ratios of sea turtles, made coral bleaching more frequent and decreased the abundance of coral-dependent fishes.[110] The report by the two science bodies in Australia found that if pollution continues to drive up global average temperatures: "Projected increases in the frequency and severity of thermal-stress events will increase the risk of mass coral-bleaching events, leading to chronic degradation of most coral reefs by the middle to late parts of the century."[111] In other words, the water would be too hot for coral reefs to continue to live.

The additional coal mined from Australia under the current expansion plan, with the rest of the major fossil fuel developments highlighted in this report, would sound the death knell for the Great Barrier Reef.

The false jobs boom and Australia's two-speed economy

The mining boom has driven up the Australian dollar, creating financial strain for the country's manufacturing, tourism, and agriculture industries, which struggle to compete internationally. In Queensland, where much of the mining boom is situated, manufacturing declined 6.5% during 2011, and the number of international tourists coming to the state has fallen 6% since the beginning of the boom.[112]

The coal industry claims mining creates jobs, and while some jobs are indeed created when mines are opened, the majority are temporary and are at the expense of jobs in other industries. The Environmental Impact Statement for the "China First" mine, a proposal from multi-millionaire resource developer Clive Palmer, states that the mine would cost over 2,000 manufacturing jobs. The Australia Institute has shown that 39 mining projects planned for Queensland would cost 20,000 jobs, mostly in manufacturing – killing one job for every two the mining industry creates.[113]

Mining and the high prices of commodities create difficulties for ordinary Australians, most noticeably increasing the cost-of-living in regional areas affected by coal mining. While some mining jobs pay well, for the 99% of Queenslanders who don't work in mining the boom results in higher housing costs and fewer jobs in tourism, manufacturing and agriculture.[114] In autumn 2012, coal companies announced hundreds of job cuts in Queensland coal mines,[115] and Australian government revenue forecasts for mining exports were dramatically revised down.[116] Yet, at the same time, volumes of coal exported are still expected to increase.[117] It's a lose-lose-lose formula for jobs, the economy, and the global climate.

Who decides?

The regulatory and assessment process in Australia is not equipped to assess and determine the impact of coal projects in the context of their contribution to climate change. Decision makers are not considering the cumulative consequences of the coal-industry expansion on global efforts to reach the goal of limiting warming to below 2°C, and environmental assessment processes at the state and national levels do not address the question of the greenhouse gas emissions produced from these proposed mines, despite Australia's commitment to the below 2°C goal. Contributing to exceeding the 2°C goal means the likely loss of the Great Barrier Reef altogether due to its inability to recover from possible annual bleaching at higher global temperatures.[118]

Rising US coal exports to feed Asia with dirty fuel

Increase in annual CO_2 by 2020: 420Mt

Country with comparable annual emissions: Mexico

Companies involved: Peabody Coal, Arch Coal, Ambre Energy.

Across the US, a combination of citizen action, new federal health standards, and economic conditions have forced the retirement of more than 100 coal-fired power plants.[119] This has cut domestic demand for coal, so mining companies are looking for new markets off shore. They are attempting to build five new export terminals in the Pacific Northwest of the US.

If the coal industry succeeds, this expansion would allow 190 million more tons of coal a year to be loaded on to ships and sold to Asia. Planned US coal export expansion would double the existing total volume of all US coal ports and has the potential to add 420 million tonnes of CO_2 pollution to the atmosphere every year well before 2020, as much CO_2 as 100 million cars.[120] The coal for the proposed terminals would be strip mined from largely publicly owned reserves in Wyoming and Montana's Powder River Basin, and transported on long coal trains through Montana, Idaho, Washington, and Oregon.

The global picture

The goal of the US coal industry is to provide China and India with a substantial source of very cheap thermal coal. This would significantly increase global carbon emissions since the supply of US coal would have an impact on the energy habits of those two countries for the next 50 years.

Permitting a massive expansion of US coal exports to increase coal consumption in Asia would specifically undermine China's progress towards more energy-efficient power generation and usage. Thomas M Power, former University of Montana economics professor, reports that "several empirical studies of energy in China have demonstrated that coal consumption is highly sensitive to cost." A recent study found that coal consumption goes up by 12% when the cost of coal drops by 10%. Another report found that over half of the gain in China's improved "energy intensity" during the 1990s was a response to price. This means that, if the US provides cheaper coal, Asia will buy more coal than would otherwise be the case.[121]

The decline in coal use in the US has made coal companies, such as Peabody and Arch, look for new markets for their dirty product. Foreign coal companies, including Australia's Ambre Energy, are also betting big on US exports and hoping to fast-track proposals without thorough review. If successful, this plan by the fossil-fuel industry to seek profits in overseas markets would lock the world into dangerous climate change and create serious public health problems in communities from Billings, Montana to China's coastal cities.

Additional impacts would also be felt in the countries importing US coal. In China, over 400 million tonnes of coal ash is already being produced annually, and toxic dust, which gets picked up by the wind, blankets cities and villages throughout the country. A 10-year study of air pollution in Beijing and Shanghai found that coal ash is a major component of China's spring dust storms, during which levels of arsenic, lead, selenium and sulphur in the air exceed normal levels by up to 53 times.[122]

Dirty trains and threatened wildlife

Hundreds of communities and sensitive ecosystems would be affected by the US coal industry's plan to transport coal from the Powder River Basin to the proposed export terminals. Dozens of 2km-long coal trains could pass through the Pacific Northwest every day, leaving a cloud of toxic coal dust and diesel fumes in their wake. According to the railway company BNSF, which is planning to haul Powder River Basin coal to the Pacific Northwest, the "amount of coal dust that escapes from PRB coal trains is surprisingly large. (…) BNSF has done studies indicating that from [200 to 900 kilograms] of coal can escape from a single loaded coal car. (…) In many areas, a thick layer of black coal dust can be observed along the railroad right of way and in between the tracks."[123]

The export route would cut through sensitive ecosystems, such as the Columbia River Gorge and Coos Bay, which are already suffering from the impacts of climate change and high mercury levels. These areas are home to several species of endangered or threatened salmon, steelhead, green sturgeon, euchalon, and leatherback sea turtles. The increase in coal train and barge traffic would have a further impact on these species. The Columbia River Gorge could see more than 40 coal trains a day.

Once the coal arrives at port terminals, it is typically kept in large piles where it is exposed to wind and weather. Stockpiles of coal at existing export terminals release fugitive emissions of coal dust into the surrounding community. The health impacts experienced by miners exposed to particulate matter from coal-dust pollution, such as asthma, bronchitis, emphysema, and other respiratory illnesses, would also become a problem in port and rail communities in the West. Coal dust contains toxic substances, including arsenic, cadmium, benzene and other volatile organic compounds that are known carcinogens. These substances have also been linked other diseases, such as strokes and lung and heart disease.[124]

The US Environmental Protection Agency recently called on the Army Corps of Engineers to conduct a comprehensive, area-wide review of all the coal export plans based on concerns that there could be "significant impacts" on the health of residents and the environment.[125] These calls were echoed by Oregon Governor John Kitzhaber, Senators Murray (D-WA) and Merkley (D-OR), and dozens of public officials in the region. Over 25 cities, counties, and ports have passed resolutions expressing concern or opposition to coal exports through the Pacific Northwest.

Who pays the bill?

While Arch, Ambre, and Peabody hope to reap sizable profits in overseas markets, the US public would unfairly shoulder much of the financial burden. The economics of these export proposals rest, in part, on a massive public subsidy delivered through the US Department of Interior's coal-leasing program that charges the companies a pittance for a valuable resource. Coal companies are given cheap access to taxpayer-owned coal, and allowed to strip mine it from public lands, through auctions run by the Bureau of Land Management (BLM). The BLM allows companies to propose and set the terms of the lease to maximise their profits. As a result, only three federal coal auctions in the past 20 years have had more than one bidder. Knowing there won't be competition, companies are free to enter the lowest possible bid for this coal. In 2012, the BLM gave Peabody access to 721 million tons of taxpayer-owned coal for $1.10 a ton.

The Institute for Energy Economics and Financial Analysis (IEEFA) estimates that the federal BLM's undervaluing of Powder River Basin coal has amounted to a public subsidy of $28.9bn to the coal industry since 1980,[126] on the backs of US taxpayers. Beyond the direct financial impacts, the federal subsidy also increases the dangerous health, environmental, and climate impacts associated with mining, transporting, and burning coal. As US coal-mining companies increasingly seek export markets, BLM's justification that leasing publicly owned coal will help "meet the national coal demand" is being scrutinised.

Indonesian government risks Kalimantan wildlife with coal exports

Key facts: Increase in annual CO_2 by 2020: 460Mt

Country with comparable annual emissions: UK

Companies involved: KPC, Adaro, BHP, Banpu

On Kalimantan, the Indonesian part of the island of Borneo, dirty coal is waiting to be unearthed. Indonesia is already the world's largest exporter of thermal coal used by power stations and it provides about half of China's coal imports.[127]

As a result of expansion in Kalimantan, Indonesia´s coal output has been surging – reaching an average growth rate of 20 % a year since 2000, from 77 million tonnes a year to 325 million tonnes in 2011.[128]

The planned increase in coal exports would produce an additional 460Mt of greenhouse gas emissions, as much CO_2 as the entire emissions of the UK in 2010.[129]

The global picture

The extra coal would not only feed a burgeoning number of coal-fired power stations being built to meet local energy demand, but would largely go overseas to China, India, South Korea, Japan, and Taiwan, adding to the thick cloak of coal smoke hanging over Asia.[130]

Who pays the bill?

Yet the value of the coal production is only 3%[131] of Indonesia's GDP, and – despite ambitious coal expansion plans – the share is set to decline as the economy grows.[132] Now, the Indonesian government is planning to spend public money on infrastructure investments and incentives that aim to dramatically increase coal exports from Kalimantan even further.[133] The toll on the people and the environment will be enormous.

To support this increase in coal exports, vast areas of Indonesian Borneo's wilderness – land with strong links to indigenous communities – have been allocated as coal mining concessions. And it's not just the new mines that will cut open the heart of Borneo, but new infrastructure for coal transportation will also be carved through the island's forests, home to one of the richest tropical forest ecosystems on the planet. The forest provides natural habitats for the endangered orangutan and other species of primates, as well as for important bird life, including the argus pheasant and hornbills.

While the Indonesian government pays lip service to environmental sustainability in the Master Plan for the Acceleration and Expansion of Indonesia's Economic Development (MP3EI), it largely ignores the terrible price those living around the mines will have to pay. Reports have surfaced of the oppression of those speaking out against the destructive mining practices.[134] The coal industry makes an intensive demand on water resources but also releases acids and sulphates into rivers. These pollutants destroy water supplies that in turn decimate fish stocks and contaminate crops, leading to loss of livelihoods, a reduction in food sources and health problems for local communities.

Since coal mining and deforestation began upstream along the Mahakam River, the World Wildlife Fund (WWF) "Heart of Borneo" report notes that flooding has become commonplace in Samarinda, in East Kalimantan. Major floods in 2008-2009 affected families and disrupted the economy, transportation, employment and livelihoods. The total cost of these floods was estimated at $9m US dollars, while the cost of flood prevention is far greater than the town's income from coal. Construction of a flood polder has already cost $7m, and the local government has put together a flood-mitigation plan that would cost another $350m.[135]

This deforestation-and-mining-induced flooding serves as an early indication of the kind of local impacts that Indonesians will experience if this dirty project goes ahead. On top of that would come the impacts of climate change on Indonesia, which include lower agricultural yields, leading to food shortages and price increases and damage to fisheries due to reduced coral reefs.[136]

Greenpeace and other groups such as Friends of the Earth Indonesia (WALHI), the Indigenous Peoples Alliance (AMAN) and the Mining Advocacy Network (JATAM) are calling for a moratorium on coal mining on Kalimantan.[137] The groups are asking the government to review existing concession permits, particularly where they overlap with areas that have already been protected under a two-year forestry moratorium on the allocation of new concessions that was declared in May 2011.[138]

Potential for renewable energy

Indonesia does not need to risk its natural environment and undermine Kalimantan's indigenous communities for the sake of development that is achieved through the unsustainable extraction of fossil fuels. There are other ways the country could meet its economic goals.

The Greenpeace Energy [R]evolution scenario for Indonesia shows how the country could meet its burgeoning energy demand with reliable, sustainable energy solutions without relying on coal. Instead of spending scarce public money on non-renewable, destructive extractive industries, the country could focus on high-value added industries, as a pathway to development.

Indonesia has the natural resources to become a leader in the provision of renewable geothermal energy. Together with other technologies such as solar and biomass, the country's renewable energy industry could be worth $40bn by 2030; and could reduce the country's dependence on coal by as much as 15%. This kind of investment could cut Indonesia's emissions by at least 10% without taking into account other emissions-reduction strategies, such as energy efficiency.[139] These renewable-energy industries would keep on boosting Indonesia's economy into the future, long after the coal had run out.

China's clinging to coal an unnecessary contradiction

Key facts: Increase in annual CO_2 by 2015: 1,400Mt

Country with comparable annual emissions: Russia

Companies involved: China Datang Corporation, China Guodian Corporation, China Huadian Corporation, China Huaneng Group, China Power investment Corporation, Shenhua Group Corporation Ltd.

The biggest dirty-energy project on the planet is the planned 20% expansion of China's coal mining and production operations in five semi-arid western and northern provinces, where most of China's remaining reserves of the dirty fuel are to be found. If the mines, coal power stations and factories planned for this area during China's current five-year plan go ahead, they would spew 1,400 million tonnes of CO_2 into the atmosphere[140] – adding more than double the amount of Germany's total emissions in 2010.

China is both the world's largest producer and consumer of coal. The fuel supplies 70% of the country's energy needs and 80% of its electricity.[141] It is, therefore, no surprise that 80% of China's carbon dioxide emissions come from burning coal.[142]

In 2009, the World Energy Council reported that China had 114.5 billion short tons of recoverable coal reserves, the third-largest in the world behind the US and Russia, and equivalent to about 14% of the world's total reserves.[143] The five western and northern provinces are planning to increase production by 830 million tons a year by 2015.[144] This expansion would be at odds with policy goals set out in the country's five-year plan that calls for curbs on air pollution, a target to limit coal consumption growth by 2015 and reductions in CO_2 emissions in relation to economic output.[145]

Climate change that challenges China

China will not escape impacts caused by dangerous climate change. The most serious risks the country faces include a decrease in food production, more severe droughts, the shrinking of glaciers that are the source of the major rivers, and more frequent extreme weather phenomena. If there are no adaption measures, a 2.5°C rise in the average global temperature would lead to as much as a 20% decline in Chinese food production.[146] It has been estimated that by the year 2050, four western provinces of China – Inner Mongolia, Xinjiang, Gansu, Ningxia – would face intense water scarcity with water demand exceeding the available water resource.[147] Water resources are already under heavy stress in some parts of the country. Taking the middle section of the Yellow River as an example, 35% of the decline in water availability between 1970-2000 has been attributed to climate change.[148] Climate change will also lead to an increase in extreme weather phenomena, including droughts, floods, and high temperatures. Statistics show that in the 1950s storms on China's coasts resulted in a direct economic loss of millions of renminbi (RMB). This increased to billions in the later part of 1980s. Now, the annual average direct economic loss is 10bn RMB ($1.6bn US dollars).[149]

Where's the water?

The provinces earmarked for new coal bases would face a serious water problem if planned coal expansion were to go ahead. By the end of 2015, the annual water consumption of the coal-power bases in Inner Mongolia, Shaanxi, Ningxia would either equal or exceed the entire area's current total industrial water consumption (94.1% to 140.8% of current total industrial consumption).[150] That would mean these coal power bases, if fully developed, would consume a significant amount of water currently allocated to farming, urban residential use, environmental conservation and other sectors. The fierce competition for water resources between industrial and non-industrial sectors would very likely cause conflict and unrest in those areas.[151]

These provinces simply could not provide the massive water allocations required for increased coal mining, coal production, and coal chemical production, not to mention for the new infrastructure and transport projects which would come along with the expansion.

Coal production and use are already responsible for more than 10% of all water usage in China.[152] Water is needed to mine and wash coal, as well as to cool coal-fired power plants. When coal mines are opened and the associated new heavy industry begins, water is secured by accessing local lakes and rivers, pumping groundwater, and constructing reservoirs to capture surface water, which diverts its normal flow and reabsorption into the soil. All three methods result in the water table sinking, leading to land degradation and desertification, damaging the livelihood of local farmer and herder communities.[153] Before coal is mined, the groundwater is extracted to allow access to the fossil fuel, resulting in large-scale groundwater depletion. It is estimated that for every ton of coal extracted, 2.5m^3 of groundwater is pumped out of the ground and contaminated.[154]

Iconic grasslands under threat

Pollution and the intense use of water have already caused desertification and degradation of some of Inner Mongolia's iconic grasslands, which herders rely on to feed their livestock. From 2004 to 2009, according to the National Bureau of Statistics, Inner Mongolia lost 46.8 million cubic metres from its total reserves of freshwater, a drop of 15%. During the same period, Xinjiang lost 95.5 million cubic metres. Some parts of the grasslands have turned into dust bowls and now cracks in the mud appear where natural lakes used to be. People in the area report that the production of the Xilingol grassland has been lowered. The Wulagai wetland has all but dried up.[155] The desert has started creeping into many other grasslands but there is still time to save many of these areas by limiting the expansion of coal mining.

Glaciers shrink under climate change

The Yellow River source region plays a vital role in supplying and regulating water to the entire water basin, with its length above Lanzhou providing 55.6% of the river's total water flow.[156] However, in the last 30 years, the region has lost 17% of its glaciers and the ice is melting at a rate that is now 10 times faster than it has been for the previous 300 years.[157]

Old coal industry cities facing pollution problem

The coal industry is the backbone of cities such as Datong City in Shaanxi Province. The intense energy consumption and heavy pollution of the coal industry have brought significant environmental problems for Datong City, including, but not limited to, pollution of river water, the destruction of ground water, land sinking due to mining, and heavy air pollution. According to monitoring from 2005 by the Datong City Environmental Department, the water quality of most of the rivers in Datong City had become so poor that the water was essentially not usable.[158] Coal contributes to 85% of China's sulphur dioxide (SO_2) emissions, 67% of its nitrogen oxides (NO_x) emissions and 70% of particulate matter (PM).[159]

Mother river struggling under industrial expansion

China's new coal-mining bases would also place further strain on the already polluted and struggling Yellow River – cradle of Chinese civilisation and the largest sandy river in the world. People in the cities and communities along the river depend on it for their livelihood. Removing too much water from the Yellow River would threaten ecosystems, cities and farming communities.

Oil pipelines threaten Canadian wilderness as tar sands greed grows

Key facts: Increase in annual CO_2 by 2020: 420 Mt

Country with comparable annual emissions: Saudi Arabia

Companies involved: include Shell, Statoil, Total and Enbridge

The Canadian tar sands, in the province of Alberta, contain enough oil to produce 54 gigatons of carbon pollution[160] – that is twice the amount of carbon dioxide emitted by global oil use in our entire history, according to NASA Scientist James Hansen.[161]

Canadian oil transport company Enbridge and oil producers are trying to boost production in the tar sands from 1.5 to 4.5 million barrels of oil per day by 2035. This additional dirty oil would add 706Mt of CO_2 to the atmosphere every year.

The total reserve in the tar sands is estimated to be 170,000 million (170 billion) barrels of oil.[162] Despite the damage posed by producing and burning this amount of oil, Enbridge wants to press ahead with a $5.5bn Canadian dollar project to build the Northern Gateway pipeline from the tar sands across the Rocky Mountains through the Great Bear Rainforest to Canada's Pacific coast, where bitumen, mixed with a toxic dilutant, would be loaded onto supertankers for transport to Asia.[163,164] Enbridge has also announced a $3.2bn project to massively increase the capacity and efficiency of its pipelines to the US.[165] Another Canadian pipeline company, TransCanada, is proposing a $7.6bn project to expand existing pipelines into the US to reach refineries in multiple locations.[166]

Carbon-intensive processing

The tar sands are huge deposits of bitumen, a tar-like substance that's turned into oil through complex and energy-intensive processes that cause widespread environmental damage. One method requires, unlike any other petroleum product, the sands to be melted with super-headed steam so that a mixture of oil and water can be pumped to the surface. This is the way the oil industry currently prefers to extract the tar sands deposits that are deep underground.

The extraction processes for tar sands deposits mean the oil is more costly to produce than regular crude, uses more water and energy, and emits more carbon.[167] For example, two tons of tar sands are needed to produce a single barrel of oil. Three to five times more water and energy are required per barrel than any other oil source known to mankind.[168] At current levels of production, the tar sands use more water every day than a city of two million people and consume enough natural gas to heat six million homes.[169]

With the tar sands, our global addiction to oil has us scraping the bottom of the barrel. The processes also pollute the Athabasca River, with an estimated 11 million litres of toxics seeping into the river everyday, lace the air with toxins, and convert pristine wilderness into wasteland.[170] The reserves lie beneath large areas of Boreal forest. Some areas are clearcut to make way for vast strip mines to develop the tar sands, the fastest growing source of greenhouse gas emissions in Canada.

The global Picture

Global oil consumption has grown only marginally after the early 2000s. Industrialised countries still burn just over half of the world's oil, but their consumption peaked in 2005 and hit the lowest level since 1995 in 2011. However, increasingly expensive and destructive oil production, such as tar sands mining and Arctic deep-sea drilling, is needed to maintain even the current level of consumption as developed oil fields are depleted.

The Canadian wilderness, as well as the Arctic, can be saved from destruction by more energy-efficient vehicles and increased use of electric transport systems powered by renewable energy. Car efficiency standards have already been put in place with good results in the EU, the US and China, among others, but they need to be ratcheted up and spread into more regions.

The true cost of mining the tar sands

Canada's indigenous First Nations communities are being affected by the tar sands. One community reports unusually high levels of rare cancers and autoimmune diseases.[171] Not only is the process of refining tar sands carbon intensive, but the tar sands themselves are comprised primarily of cancer-causing polycyclic aromatic hydrocarbons.[172] While the tar sands are often touted as Canada's economic driver, from a social-costs standpoint, people in the tar sands regions are paying a hefty price. Substance abuse, suicide, gambling and family violence have increased in the tar sands areas.[173] The Alberta government has been cutting essential social services from hospital beds to Aboriginal services, while oil companies rake in record profits. And while the tar sands create jobs in the short term, two out of three jobs are in construction, meaning once the initial work is completed, those jobs disappear.[174] The thousands of workers who have been brought in from outside the region have generated a housing crisis in northern Alberta as demand outstrips supply. Inflation in Edmonton and Calgary has also skyrocketed.[175]

Government-backed destruction

Yet despite all of these social and environmental problems, the Alberta government has approved 100% of proposed tar sands projects that currently generate 40 million tons[176] of CO_2 a year, more than all the cars in Canada combined. These emissions are before the oil is burned, mainly in the US now. Alberta currently has the capacity to produce about 1.8 million barrels of oil a day from the tar sands. There are, however, projects under construction, or with all the necessary permits required, to expand this to 4.8 million barrels a day. Additionally, there are an intended 3.5 million barrels a day that have been announced or are undergoing regulatory review, including two new massive open pit mines from Shell.[177]

The Enbridge "Northern Gateway" pipeline proposal – which is backed by the Harper government – threatens to allow a 28% expansion in tar sands development on 2008 levels.[178] This pipeline would span 1,170km from the tar sands in Alberta, across the iconic Rocky Mountains, then across the Great Bear Rainforest in British Columbia, the last intact temperate rainforest in the world, and end up on the coast of the rainforest.

The new Northern Gateway pipeline, if built, would cross 1,000 rivers and streams on the way to the pristine coastline. The pipeline would bring more than 200 crude-oil tankers through some of the world's most treacherous waters each year, cutting across the migratory path of grey whales and the feeding zones of orca whales. The potential for oil spills contaminating the sensitive Great Bear Rainforest coast from tanker traffic moving tar sands oil to market, mainly in Asia, is high. Over the past decade, Enbridge's existing pipelines have spilled, on average, more than once a week. It is an environmental disaster waiting to happen.[179]

Communities call for Harper government to see the light

The massive pipeline-expansion projects are currently before an expedited review created by the Harper government. The government has also legislated to give itself the power to overthrow the findings of the review. Greenpeace along with concerned Canadians, including members of First Nations, are calling for the Canadian federal government to see the light, overturn its active support for the project and decline permission for new tar sands pipelines.

Pristine Arctic under threat from risky oil-drilling plans

Key facts: Increase in annual CO_2 by 2020: 520Mt

Country with comparable annual emissions: Canada

Companies involved: include Shell, Gazprom, Cairn Energy, Exxon Mobil, Rosneft, Statoil.

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There's an oil rush heading for the Arctic. If fossil fuel companies succeed with their plans to exploit oil and gas reserves in this fragile environment, there is the potential to add 975Mt of CO_2 to the atmosphere each year, by 2027 – more greenhouse gas emissions than Germany and the Netherlands combined in 2010.[180]

As oil prices rise, fossil fuel companies, including Shell, Gazprom, Cairn Energy and Statoil, are snapping up licences to explore for oil they think lies under the freezing Arctic seas. Companies have pressured governments to allow more and more dangerous drilling with plans to extract 3 million barrels of oil a day by 2030.

One of the world's last pristine environments, the Arctic, is caught in a deadly cycle. The region is warming twice as fast as the rest of the globe and is already experiencing some of the most severe climate impacts on Earth.[181] The irony is that as climate change melts the Arctic sea ice at record speeds,[182] it gives access to the Arctic's hydrocarbon stores which may hold up to 90 billion barrels of oil – 13% of the world's remaining oil reserves and enough to meet global demand for three years.[183]

High-risk stakes ignored as gold rush mentality takes hold

Corporations have recently spent billions of dollars trying to open up the Arctic to new oil development, even though drilling there is a dangerous, high-risk and costly enterprise. Oil and gas have been identified in 25 geological areas in the Arctic, most of them offshore.[184]

In the Russian Arctic, investment in offshore oil could top $500bn US dollars.[185] For example, in 2011, Russia's state company Rosneft struck a multi-billion dollar strategic alliance with ExxonMobil to explore the Arctic's remote Kara Sea for oil.[186] This is despite the fact that Cairn spent hundreds of millions of pounds hiring oil rigs, transporting them to the Arctic, only to then abandon its drilling plans when it found no commercially extractable oil,[187] while earlier this year Shell scrapped its planned drilling in Alaska at significant cost.[188]

An oil spill under these icy waters would have a catastrophic impact on a unique and one of the most beautiful landscapes on earth. The extremes of Arctic weather, which include hurricane-force winds, 10-metre seas, sub-zero temperatures and winter darkness, as well as its remote location, severely increase the risks, complicate logistics and present unparalleled difficulties for any clean-up operation.[189] Oil rigs face an almost ever-present risk from huge icebergs. Companies have to employ fleets of ships to drag them out of the way. However, some of the icebergs are so big that oil rigs are forced to stop drilling and move out of their way.

The Arctic drilling season is limited to a narrow window of a few months during the summer because of the return of winter sea-ice cover. In this short period of time, completing the huge logistical response needed to cap a leaking well would be almost impossible. For instance, the successful drilling of vital relief wells, crucial to permanently capping a ruptured well, could not be guaranteed before the winter ice returns.[190] If relief wells are left unfinished over the winter, oil could continue to gush out for up to two years. Yet despite these incredible risks, oil companies continue to recklessly lobby governments to relax safety rules for Arctic drilling.[191]

BP's response to the Gulf of Mexico oil spill is a case study in how difficult dealing with an Arctic spill could be. BP needed over 6,000 ships, more than 50,000 people and a massive cheque book to cap its leaking well, and even then it didn't manage it for months, causing the biggest environmental disaster in US history.[192] Oil companies operating in the far north would simply not be able to mobilise this sort of response, as the US Coast Guard has admitted.[193]

If the fossil fuel industry cannot adequately respond to a spill in temperate conditions near to large population centres and with the best response resources available, how can we be assured by claims that they are prepared to deal with a spill in the extreme Arctic environment? A top US Coast Guard's official recently admitted that they currently have "zero" spill response capability in the Arctic.[194]

Indigenous communities and wildlife standing in the way

At risk in this mad oil rush are the Arctic's fragile ecosystem and the livelihoods of the region's local and Indigenous communities. The Arctic is home to a diverse range of unique wildlife, including polar bears, bearded seals, bowhead and blue whales, narwhal and salmon shark, and birds such as Brünnich's guillemot and gyrfalcon. In fact, the Arctic is home to hundreds of species of seabirds. The Alaska Maritime National Wildlife Refuge alone is habitat for 40 million seabirds.[195] The impact of a spill on these communities and on already-vulnerable animal species would be devastating and long-lasting. Even if there is no spill in the short term, toxic red-listed chemicals are often used in the drilling process and then dumped at sea, polluting the pristine environment and negatively affecting the local marine life.

A spill in the Arctic would have dire consequences for the local Indigenous peoples who inhabit the region and rely on the sea and ice for their livelihood. The US Geological Survey found that the long-term impact of oil development on Indigenous communities is unknown, because "additional information" is required to "determine the potential hazard to native subsistence livelihoods.

Brazil risks marine life by drilling miles under the sea for oil

Key facts: Increase in annual CO_2 by 2020: 330Mt

Country with comparable annual emissions: South Africa

Companies involved: include Petrobrás, BP, Shell, Chevron, Total, Statoil

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Brazil is rich in commodities. It is already the world's biggest exporter of beef, soya, sugar, and orange juice. Now it wants to add oil to that list after geologists found the largest deposit of oil in the Americas in 30 years. Between 50 and 100 billion barrels of oil are estimated to lie 8km below sea level, beneath a shifting layer of cretaceous salt deposits in an area covering over 112 thousand km^2 or the size of New York State.[196] The oil companies plan to extract as much as 2 million barrels a day by 2020. That would add 330Mt a year of carbon pollution to the atmosphere – as much as South Africa produced in 2010.[197]

Major oil companies operate in the pre-salt fields of Brazil, including Chevron, Statoil and Shell, and a number of new oil and gas service companies have been developed. Keen to cash in, Petrobrás, the state-owned fossil fuel company, plans to invest $53bn US dollars in exploration and production activities by 2015, up from $33bn in 2010.[198]

The Brazilian government has been licking its lips ever since the 2007 discovery, with then-president Luiz Inácio Lula da Silva declaring God was Brazilian for providing the reserves. His successor, Dilma Rousseff, a former energy minister who was chairman of Petrobrás for seven years during Lula's administration, has called the reserves her nation's "passport to the future".[199]

Passport to climate destruction

But exploiting these oil reserves is not only a step backwards for the climate but also a step back for the environment. The reserves are trapped beneath a hard-to-penetrate layer of salt which is up to 1.9km thick plus layers of rock almost 5km thick and kilometres of seawater. This poses technical problems and risks not faced by the fossil fuel industry anywhere else in the world.[200] For example, the Tupi field lies under 2.2km of water, almost a kilometre deeper than the 1.5km of water at BP's *Deepwater Horizon* rig[201]. Underneath the water is 4.87km of rock. To access the oil, drills have to withstand unparalleled pressure from all the water and rock, as well as temperatures of up to 198°C and the corrosive nature of the rock and salt.[202] The salt is very resistant to drills and interferes with imaging technology.[203]

The pre-salt stores are formed by carbonates, a special kind of rock whose physical, mechanical, thermal and chemical properties are not well understood. The plastic and fluid features of this material may cause drill bits to get stuck during drilling. To get to the oil, drilling has to take a circuitous route rather than a vertical one in order to obtain the best performance. But changing the direction of drills could cause landslides in well tunnels, threatening the stability of the whole undersea area.

The technical challenges are enormous and the risks considerable. Furthermore, the amount of oil is just an estimate. The huge platform, shipping and drilling logistics required to extract this oil are not worth the investment as other, cheaper, cleaner sources of energy are already available (see page XX "Solutions for oil").

With such untested technology being used, these plans to drill deep under the seabed threaten Brazil's rich ocean ecosystems including whales' mating areas and coral reefs. The chemicals used to disperse oil sheens from the Deepwater horizon spill in the Gulf of Mexico in 2010 were still found in people's bodies and affecting their health a year after the disaster.[204] That event killed 11 people,[205] and spewed nearly 5 million barrels of oil into the ocean.[206] Currently, the true potential impact of drilling for oil under the pre-salt layers off Brazil is unpredictable. The country has so far failed to develop any kind of risk assessment let alone emergency plans for such drilling.

Deep-sea oil already causing pollution

A spill has already occurred off the coast of Brazil. In November 2011, at Chevron's $3.6bn Frade deep-sea-oil field, 370km northeast of Rio de Janeiro, a massive drill bit punctured an oil reservoir.[207] More than 400,000 litres of oil spilled from undersea rock over two weeks. The main drilling contractor at the rig, Transocean Ltd, was also in charge of the *Deepwater Horizon* rig. Chevron has had its licence to drill suspended by the Brazilian authorities until the cause of the leak is ascertained.[208] Brazilian prosecutors have charged 17 Chevron and Transocean executives for "crimes against the environment".[209] The companies are also being sued by the prosecutors for $10.6bn in damages and have already been fined more than $100m by the state. Wells in the vicinity have continued to leak this year, but still the Brazilian government promotes this vision of a dirty fuel future.[210]

Even after recent spills, a contingency plan is still waiting to be agreed to by the Brazilian government. In the US, on the other hand, the Oil Spill Liability Trust Fund counts on a budget of up to $1bn to clean up oil spills and repair damage caused to third parties in these situations.

Renewable opportunity for Brazil

The irony is that Brazil is actually a world leader when it comes to renewable energy. Sugarcane-based ethanol powers 20% of its road transport, and the country gets 85% of its electricity from hydropower, biomass and wind power.[211]

Brazil could be the first of the up-and-coming BRIC nations (Brazil, Russia, India and China) and the first large economy completely powered by renewable energy, thereby completely insulating it from the vagaries of international fossil-fuel markets. Brazil's push towards renewable energy is one of the world's most ambitious, bolstered by its pledge to reduce carbon emissions 39% by 2020.

The global renewable-energy leadership demonstrated by Brazil is undermined by the dangerous and expensive business of drilling for pre-salt oil. Exporting dirty, deep-sea oil produces masses of carbon pollution that will threaten not only Brazil's, but global efforts, to reduce emissions and limit dangerous climate change. The country has an opportunity to truly be a world leader by turning its back on risky deep-sea oil drilling and replacing the income through exporting its renewable technologies and thus creating thousands of green jobs.

Brazil could also be ambitious in fuel efficiency. Until now, Brazil has played a retrogressive role in addressing the transport sector. Federal government measures to reduce Brazil's oil demand have been delayed and the government has approved and promoted policies to stimulate the economy by reducing taxes on vehicles to increase car sales and is regulating to keep the price of fuel low.

The transport sector is the biggest fossil CO_2 emitter in Brazil, larger than power generation or industry.[212] Yet Brazil has no fuel-economy standards for cars, unlike the US, China and the EU. This lack of fuel economy standards contributes to greater emissions and greater costs for the average Brazilian. If regulations on fuel efficiency were improved and alternative clean sources of energy were developed in Brazil and globally, demand for oil could be reduced dramatically, removing the need to embark on the path of dangerous pre-salt exploration

Raising awareness of the pre-salt risks

Since the Brazilian government set the regulatory framework for drilling pre-salt reserves in 2009, Greenpeace Brazil has worked to raise awareness of the impact on the global climate of the estimated total emissions of greenhouse gases of the reserves. In two reports, Greenpeace highlighted the conflict of oil exploration with marine conservation and the consequences for the climate if all the oil currently produced in the country were burned. Greenpeace also championed the recent development of renewable energy sources such as solar, wind and biomass in different regions of Brazil and the positive impacts of exploring this potential. More recently, Greenpeace has publicly asked for a contingency plan for oil spills, especially after the Chevron accident in 2011.

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