

SEPTEMBER 2016



THE SKY'S LIMIT

WHY THE PARIS CLIMATE GOALS REQUIRE A
MANAGED DECLINE OF FOSSIL FUEL PRODUCTION



PUBLISHED IN COLLABORATION WITH



This report was researched and written by Greg Muttitt with contributions from Hannah McKinnon, Lorne Stockman, Steve Kretzmann, Adam Scott, and David Turnbull. It was edited by Collin Rees. All are with Oil Change International.

Oil Change International is a research, communications, and advocacy organization focused on exposing the true costs of fossil fuels and facilitating the coming transition towards clean energy.

Oil Change International
714 G Street SE
Washington,
DC 20003 USA
www.priceofoil.org

The author is grateful for feedback from the following reviewers:

Andrew Grant and James Leaton of Carbon Tracker Initiative, Mohamed Adow of Christian Aid, Wendel Trio of Climate Action Network Europe, Fabio Sferra of Climate Analytics, Mark Fulton of Energy Transition Advisers, György Dallos of Greenpeace International, Nnimmo Bassey of the Health of Mother Earth Foundation, Joeri Rogelj of IIASA, Andrea Bassi of IISD, Red Constantino of the Institute for Climate and Sustainable Cities, Anabella Rosemberg of ITUC, Jeremy Brecher and Joe Uehlein of the Labor Network for Sustainability, Malte Meinshausen of Melbourne University, Franz Matzner of NRDC, Elizabeth Bast and Janet Redman of Oil Change International, Shelagh Whitley of the Overseas Development Institute, Alex Pfeiffer of Oxford University, Lena Moffitt of the Sierra Club, Pete Erickson and Sivan Kartha of the Stockholm Environment Institute, and Brett Fleishman and Duncan Meisel of 350.org.

Design: paul@hellopaul.com

Cover Image: Looking west from Qian'an, iron and steel plant smokestacks. Hebei Province, China, 2014.
©Lu Guang/Greenpeace.

September 2016

Published by Oil Change International (www.priceofoil.org), in collaboration with:

350.org	http://www.350.org
Amazon Watch	http://amazonwatch.org
Asian Peoples' Movement on Debt and Development	http://www.apmdd.org
Australian Youth Climate Coalition	http://www.aycc.org.au
Bold Alliance	http://boldnebraska.org/tag/bold-alliance
Christian Aid	http://www.christianaid.org.uk
Earthworks	https://www.earthworksaction.org
Equiterre	http://www.equiterre.org
Global Catholic Climate Movement	https://catholicclimatemovement.global
Health of Mother Earth Foundation	http://www.homef.org
Indigenous Environmental Network	http://www.ienearth.org
IndyAct	http://www.indyact.org
Rainforest Action Network	http://www.ran.org
STAND.earth	http://www.stand.earth

IF YOU'RE IN A HOLE,
STOP DIGGING

CONTENTS

Executive Summary	5
1 Climate Science and Carbon Budgets	11
2 Enough Oil, Gas, and Coal Already in Production	17
3 Trimming the Excess	26
4 Why Fossil Fuel Supply Matters	31
5 Making an Energy Transition Happen	36
6 Conclusion	45
Appendix 1: Definitions of Reserves	46
Appendix 2: Assumptions on Land Use and Cement Production	47
Appendix 3: Carbon Capture and Storage	48
Appendix 4: Oil and Gas Requirement in Clean Energy Scenarios	50
References	52

ABBREVIATIONS USED IN THIS REPORT

AR5	Fifth Assessment Report of the IPCC
Bbl	Barrel
Bn Bbl	Billion Barrel
Bcf/d	Billion Cubic Feet Per Day
BNEF	Bloomberg New Energy Finance
°C	degrees Celsius
CCS	Carbon Capture and Storage
CO ₂	Carbon Dioxide
EV	Electric Vehicle
GDP	Gross Domestic Product
Gt	Billion Metric Tons
Gtce	Billion Metric Tons of Coal Equivalent
GtCO ₂	Billion Metric Tons of Carbon Dioxide
GW	Billion Watts (A Measure of Power)
GWh	Billion Watt-Hours (A Measure of Energy, or Power Supplied/Used Over Time)
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use, Land Use Change and Forestry
mbd	Million Barrels Per Day
Mt	Million Metric Tons
Mtoe	Million Tons of Oil Equivalent
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
SEI	Stockholm Environment Institute
Tcf	Trillion Cubic Feet
TW	Terawatts
UNFCCC	United Nations Framework Convention on Climate Change



EXECUTIVE SUMMARY

In December 2015, world governments agreed to limit global average temperature rise to well below 2°C, and to strive to limit it to 1.5°C. This report examines, for the first time, the implications of these climate boundaries for energy production and use. Our key findings are:

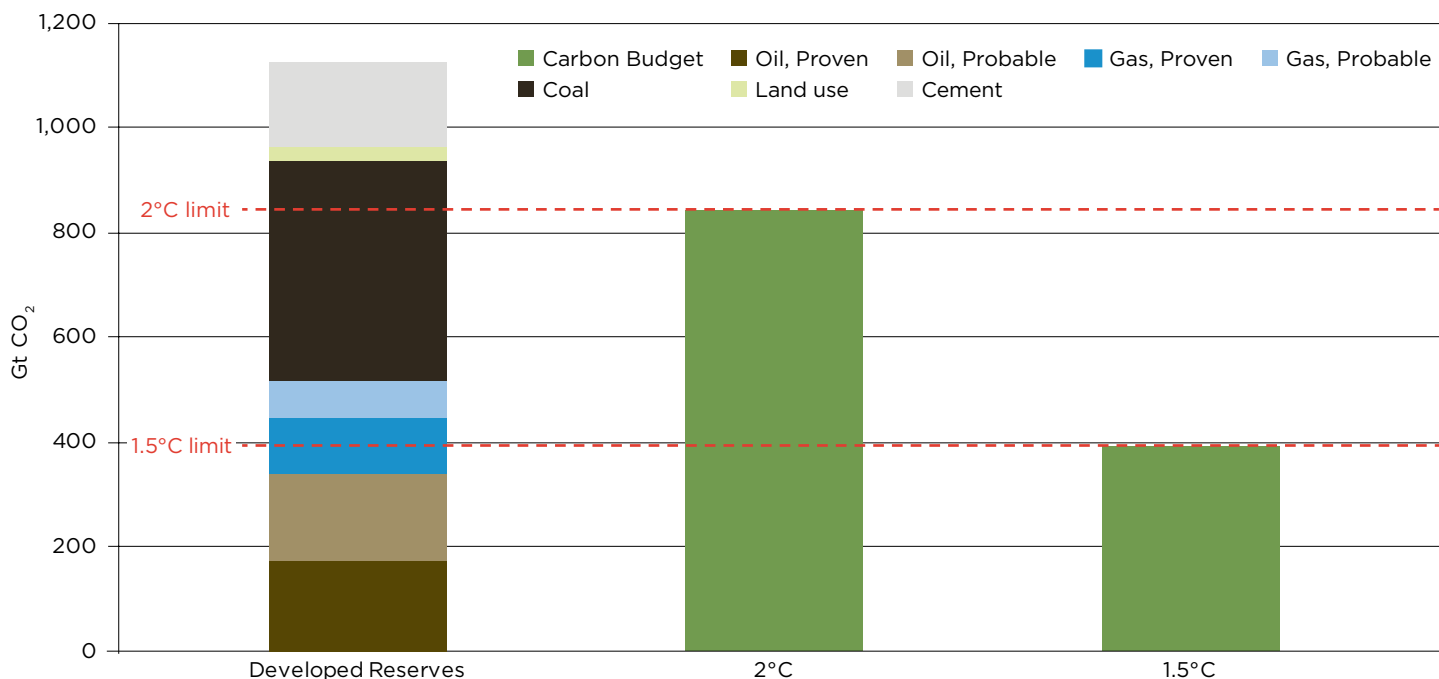
- ❖ The potential carbon emissions from the oil, gas, and coal in the world's currently operating fields and mines would take us beyond 2°C of warming.
- ❖ The reserves in currently operating oil and gas fields alone, even with no coal, would take the world beyond 1.5°C.
- ❖ With the necessary decline in production over the coming decades to meet climate goals, clean energy can be scaled up at a corresponding pace, expanding the total number of energy jobs.

One of the most powerful climate policy levers is also the simplest: stop digging for more fossil fuels. We therefore recommend:

- ❖ No new fossil fuel extraction or transportation infrastructure should be built, and governments should grant no new permits for them.
- ❖ Some fields and mines – primarily in rich countries – should be closed before fully exploiting their resources, and financial support should be provided for non-carbon development in poorer countries.
- ❖ This does not mean stopping using all fossil fuels overnight. Governments and companies should conduct a managed decline of the fossil fuel industry and ensure a just transition for the workers and communities that depend on it.

In August 2015, just months before the Paris climate talks, President Anote Tong of the Pacific island nation of Kiribati called for an end to construction of new coal mines and coal mine expansions. This report expands his call to all fossil fuels.

Figure ES-1: Emissions from Developed Fossil Fuel Reserves, Plus Projected Land Use and Cement Manufacture



Sources: Rystad Energy, International Energy Agency (IEA), World Energy Council, Intergovernmental Panel on Climate Change (IPCC)

ENOUGH ALREADY

The Paris Agreement aims to help the world avoid the worst effects of climate change and respond to its already substantial impacts. The basic climate science involved is simple: cumulative carbon dioxide (CO₂) emissions over time are the key determinant of how much global warming occurs.^a This gives us a finite *carbon budget* of how much may be emitted in total without surpassing dangerous temperature limits.

We consider carbon budgets that would give a likely (66%) chance of limiting global warming below the 2°C limit beyond which severe dangers occur, or a medium (50%) chance of achieving the 1.5°C goal. Fossil fuel reserves – the known below-ground stocks of extractable fossil fuels – significantly exceed these budgets. For the 2°C or 1.5°C limits, respectively 68% or 85% of reserves must remain in the ground.

This report focuses on the roughly 30% of reserves in oil fields, gas fields, and coal mines that are already in operation or under construction. These are the sites where the necessary wells have been (or are being) drilled, the pits dug, and the pipelines, processing facilities, railways, and export terminals constructed. These *developed reserves* are detailed in Figure ES-1, along with assumed future emissions from the two major non-energy sources of emissions: land use and cement manufacture.

We see that – in the absence of a major change in the prospects of carbon capture and storage (CCS):^b

- ⊗ The oil, gas, and coal in already-producing fields and mines are more than we can afford to burn while keeping likely warming below 2°C.
- ⊗ The oil and gas alone are more than we can afford for a medium chance of keeping to 1.5°C.

a The carbon budgets approach does not apply to other greenhouse gases, whose effects are factored into the calculation of carbon budgets in the form of assumptions about their future emissions.

b CCS has not been successfully deployed at scale despite major efforts, and there are doubts as to whether it will ever be affordable or environmentally safe.

WHEN YOU'RE IN A HOLE, STOP DIGGING

Traditional climate policy has largely focused on regulating at the point of emissions, while leaving the supply of fossil fuels to the market. If it ever was, that approach is no longer supportable. Increased extraction leads directly to higher emissions, through lower prices, infrastructure lock-in, and perverse political incentives. Our analysis indicates a hard limit to how much fossil fuel can be extracted, which can be implemented only by governments:

- ⊗ No new fossil fuel extraction or transportation infrastructure should be built, and governments should grant no new permits for them.^c

Continued construction would either commit the world to exceeding 2°C of warming, and/or require an abrupt end to fossil fuel production and use at a later date (with increasing severity depending on the delay). Yet right now, projected investment in new fields, mines, and transportation infrastructure over the next twenty years is \$14 trillion – either a vast waste of money or a lethal capital injection. The logic is simple: whether through climate change or stranded assets, a failure to begin a managed decline now would inevitably entail major economic and social costs.

The good news is that there is already progress toward stopping new fossil fuel development. China and Indonesia have declared moratoria on new coal mine development, and the United States has done so on federal lands. These three countries account for roughly two-thirds of the world's current coal production. In 2015, U.S. President Barack Obama rejected the proposed Keystone XL tar sands pipeline by noting that some fossil fuels should be left in the ground, and there is growing recognition of the importance of a climate test in decisions regarding new fossil fuel infrastructure.^d There is an urgent need to make the coal moratoria permanent and worldwide, and to stop new oil and gas development as well.

Ending new fossil fuel construction would bring us much closer to staying within our carbon budgets, but it is still not enough to achieve the Paris goals. To meet them, some early closure of existing operations will be required. Every country should do its fair share, determined by its capacity to act, along with its historic responsibility for causing climate change. With just 18% of the world's population, industrialized countries have accounted for over 60% of emissions to date, and possess far greater financial resources to address the climate problem.

Most early closures should therefore take place in industrialized countries, beginning with (but not limited to) coal. While politically pragmatic, the approach of stopping new construction tends to favor countries with mature fossil fuel industries; therefore, part of their fair share should include supporting other countries on the path of development without fossil fuels, especially in providing universal access to energy. Therefore:

- ⊗ Some fields and mines – primarily in rich countries – should be closed before fully exploiting their reserves, and financial support should be provided for non-carbon development in poorer countries.

Additionally, production should be discontinued wherever it violates the rights of local people – including indigenous peoples – or where it seriously damages biodiversity.

c This does not mean stopping all capital investment in existing field and mines, only stopping the development of new ones (including new project phases).

d <http://ClimateTest.org>

A MANAGED DECLINE AND A JUST TRANSITION

Stopping new construction does not mean turning off the taps overnight. Existing fields and mines contain a finite stock of extractable fossil fuels. Depleting these stocks, even including some early closures, would entail a gradual transition in which extraction rates would decline over a few decades. This is consistent with a rate of expansion of clean energy that is both technically and economically possible.

We consider a simple modelling of world energy sources under two scenarios: 50% renewable energy by 2035 and 80% by 2045, both with a complete phase-out of coal usage, except in steel production. It is compared with the projected oil and gas extraction from existing fields alone.

We conclude that:

- ⊗ While existing fields and mines are depleted over the coming decades, clean energy can be scaled up at a corresponding pace.

While this pace of renewable energy expansion will require policy support, it continues existing trends. In many countries – large and small, rich and poor – clean energy is already being deployed at scale today. Denmark now generates more than 40% of its electricity from renewable sources, Germany more than 30%, and Nicaragua 36%. China is now the largest absolute generator of renewable electricity, and expanding renewable generation quickly. In most contexts, the costs of wind and solar power are now close to those of gas and coal; in some countries renewable costs are already lower. The expansion of renewable energy will be harder where there are weak grids in developing countries, hence the importance of climate finance in supporting a non-carbon transition.

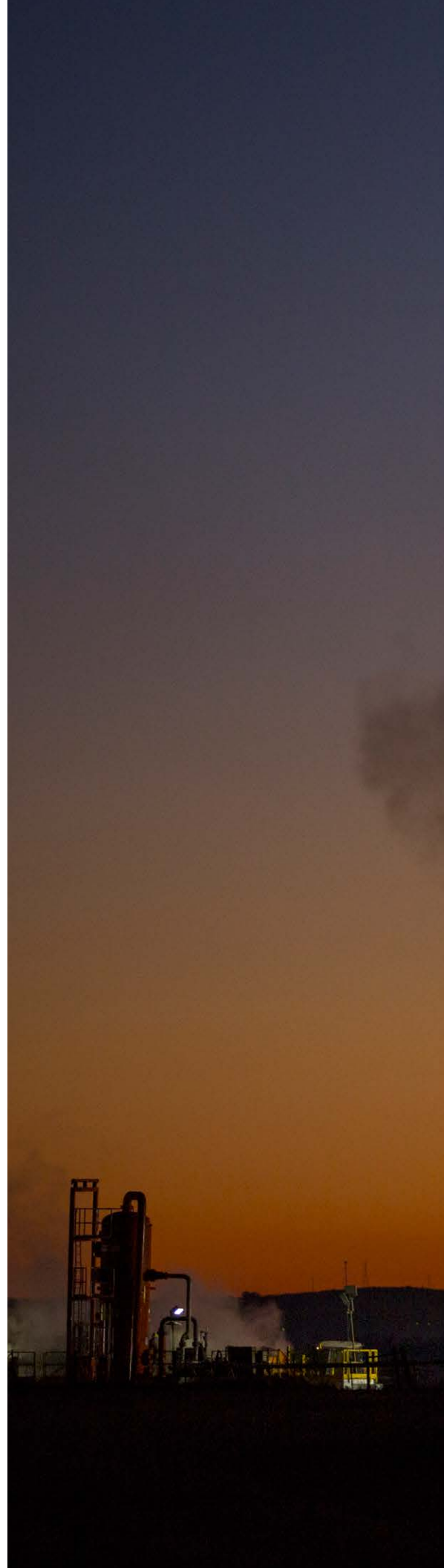
As for transportation, electric vehicles are now entering the mainstream and are on course to soon be cheaper than gasoline or diesel cars. With sufficient policy support and investment, the growth in clean energy can match the needed decline in fossil fuel extraction and use.

While there are clear advantages to clean energy – lower costs, greater employment, reduced local pollution, and ultimately greater financial returns – the transition will not be painless. Energy workers' skills and locations may not be well matched to the new energy economy. Whole communities still depend on fossil fuel industries. There is a vital need for a careful, just transition to maximize the benefits of climate action while minimizing its negative impacts.

Governments should provide training and social protection for affected energy workers and communities. Where appropriate, they should require energy companies to offer viable careers to their workers in non-carbon areas of their business. Governments should also consult with communities to kick-start investments that will enable carbon-dependent regions to find a new economic life. Waiting is not an option; planning and implementation must begin now:

- ⊗ Governments and companies should conduct a proactively managed decline of the fossil fuel industry and ensure a just transition for the workers and communities that depend on it.

A flare burns near a hydraulic fracturing drilling tower in rural Weld County in northern Colorado, the most intensively fracked area in the United States.





Aerial view of seismic lines and a tar sands mine in the Boreal forest north of Fort McMurray, northern Alberta.

