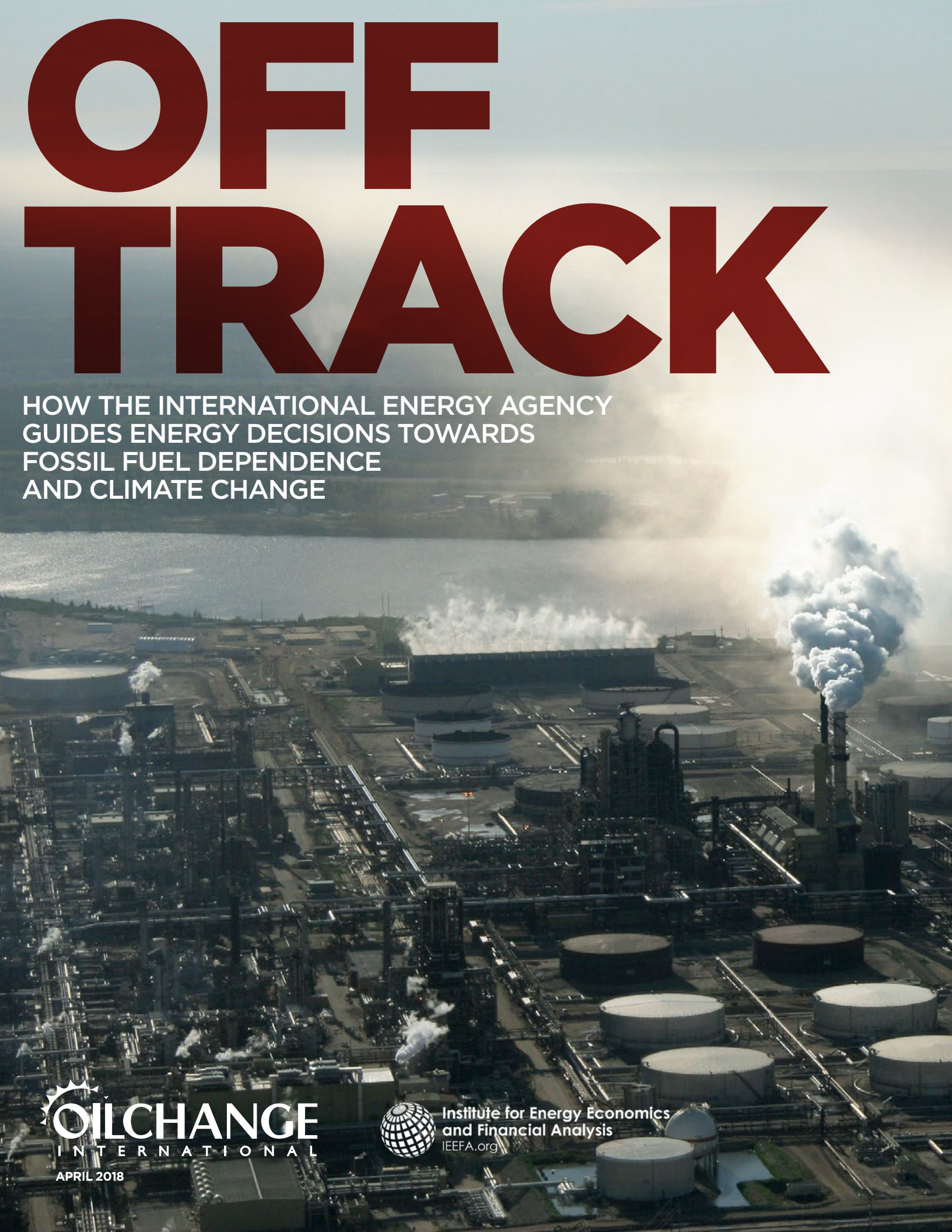
OFF TRACK

HOW THE INTERNATIONAL ENERGY AGENCY GUIDES ENERGY DECISIONS TOWARDS FOSSIL FUEL DEPENDENCE AND CLIMATE CHANGE



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This report was researched and written by Greg Muttitt,
with contributions from Adam Scott and Tim Buckley.
It was edited by Collin Rees. Greg, Adam, and Collin are with Oil Change International and Tim is with IEEFA.

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

The Institute for Energy Economics and Financial Analysis (IEEFA) conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy.

Institute for Energy Economics and Financial Analysis
River's Edge
3430 Rocky River Drive
Cleveland, OH 44111
http://ieefa.org/

A FALLEN LIGHTHOUSE IS MORE DANGEROUS THAN A REEF

CHINESE PROVERB[1]

EXECUTIVE SUMMARY

The International Energy Agency (IEA) is the world's most influential source of energy information. Its stated aim is to support decisions in governments and in the private sector, "to ensure reliable, affordable and clean energy."[2]

To achieve this, it must advise governments and others on how to address the biggest energy challenge of the twenty-first century: preventing dangerous climate change. All 30 of the IEA's member countries have signed the Paris Agreement, committing to keeping warming well below 2 degrees Celsius above pre-industrial levels, and pursuing efforts to keep it to 1.5 degrees.

However, in this report we find that the IEA is holding governments back from achieving those goals. The IEA's roadmap "New Policies Scenario" (NPS), the world's foremost guide to decisions on energy policies and investments, steers those decisions towards levels of fossil fuel use that would cause severe climate change:

- Emissions under the NPS would make the Paris goals unachievable, exhausting the carbon budget for the 1.5 degrees Celsius limit by 2022, and for a 2 degrees limit by 2034.[a]

- Of the NPS' recommended upstream oil and gas investment, between 78 and 96 percent – USD 11.2 to 13.8 trillion over 2018 to 2040 – is incompatible with the Paris goals *(Figure ES-1).*

This excess investment should be urgently redirected into clean energy. Investment in fossil fuels beyond what is aligned with the Paris goals can lead to two possible outcomes. Either the sunk capital locks in emissions, causing the goals to be missed. Or the goals are achieved and the capital is wasted, potentially leading to economic upheaval. In calling for too much investment in fossil fuel supply, the IEA greatly increases the likelihood of one of these two outcomes occurring. Like a fallen lighthouse, the IEA has become a dangerous guide.

The IEA also aims to describe what would be needed to achieve the Sustainable Development Goals, but fails to match this prescription up with the Paris Agreement goals:

- Emissions under the IEA's alternative "Sustainable Development Scenario" (SDS) would exhaust the 1.5-degree Celsius carbon budget by 2023 and the 2-degree budget by 2040 (*Figure ES-2*).

- The SDS has the same emissions profile as the IEA's Copenhagen-era 450 Scenario (450S), which gives only a 50 percent chance of keeping warming below 2 degrees Celsius (*Figure ES-3*).

- Of the SDS' recommended upstream oil and gas investment, between 70 and 94 percent would be surplus to the Paris goals (*Figure ES-1*). Investors testing their portfolios against the SDS or 450S would be potentially undervaluing climate transition risk.

The remaining carbon budgets associated with the Paris goals are now extremely small: at current rates of emissions, the 1.5 degree budget will be exhausted in eight years, and the 2 degree budget in nineteen years.[3] By accepting a mere 50 percent probability of success, by assuming negative emissions technologies will be invented, and by assuming unrealistically low non-energy emissions, the SDS significantly understates the degree of change in energy systems needed to achieve the goals.

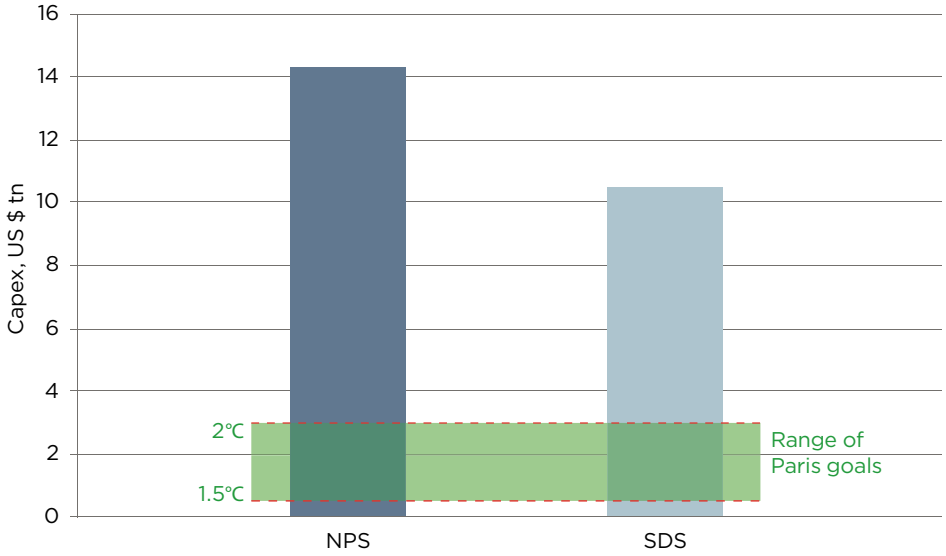
The IEA is now seeking to broaden its country constituency beyond OECD members, by inviting major Southern countries to become associate members. We find two conflicts of interest:

- Contrary to the principle of Common but Differentiated Responsibilities, the IEA expects the majority of emissions reductions to occur in non-OECD countries *(Figure ES-4)*. This is both unjust and understates the needed cuts in IEA full-member countries. For example, the SDS has India cutting its 2040 emissions by 46 percent compared to the NPS, despite its pressing developmental needs, but the European Union by only 40 percent.[4]

- At least two of the authors of the IEA's latest flagship publication *World Energy Outlook* (*WEO*) were staff on secondment from oil companies, which continued to pay their salaries while they were writing the *WEO*.[5]

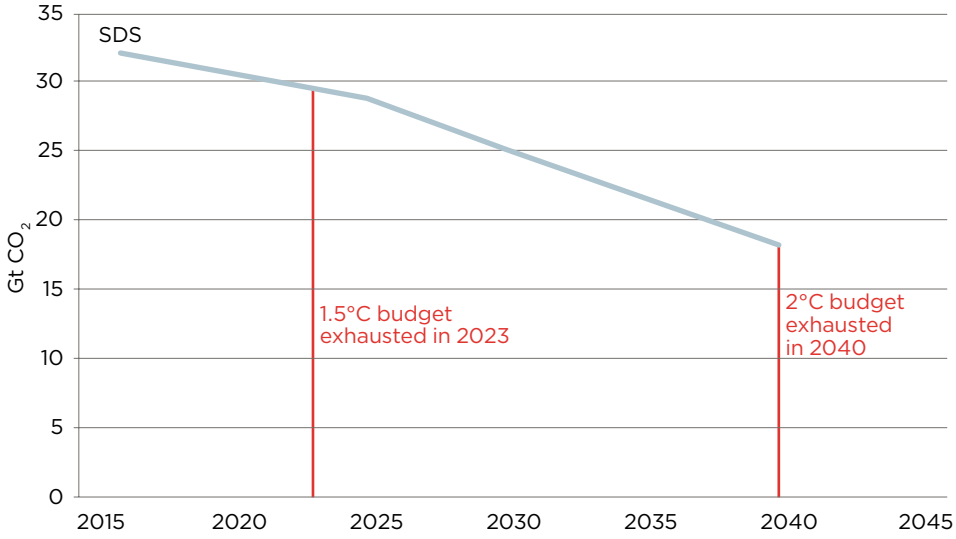
a We use the IPCC's carbon budgets for a 50 percent probability of achieving the 1.5 degree goal, and for a 66 percent probability of staying below 2 degrees Celsius. On a precautionary basis, we assume that negative emissions technologies other than afforestation will not be available, as so far they exist only in theoretical models.

Figure ES-1: Cumulative Capital Expenditure in Oil and Gas Extraction, 2018-40, in IEA Scenarios Compared to Paris Goals



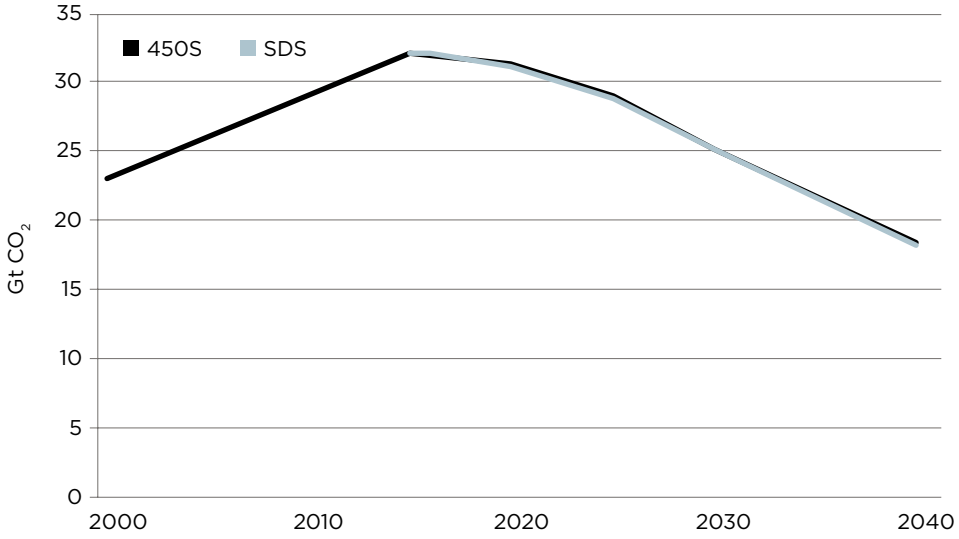
Sources: IEA, Rystad Energy, Oil Change International analysis, IPCC, Global Carbon Project[6]

Figure ES-2: IEA Sustainable Development Scenario Emissions versus Paris Goals (assuming no negative emissions)



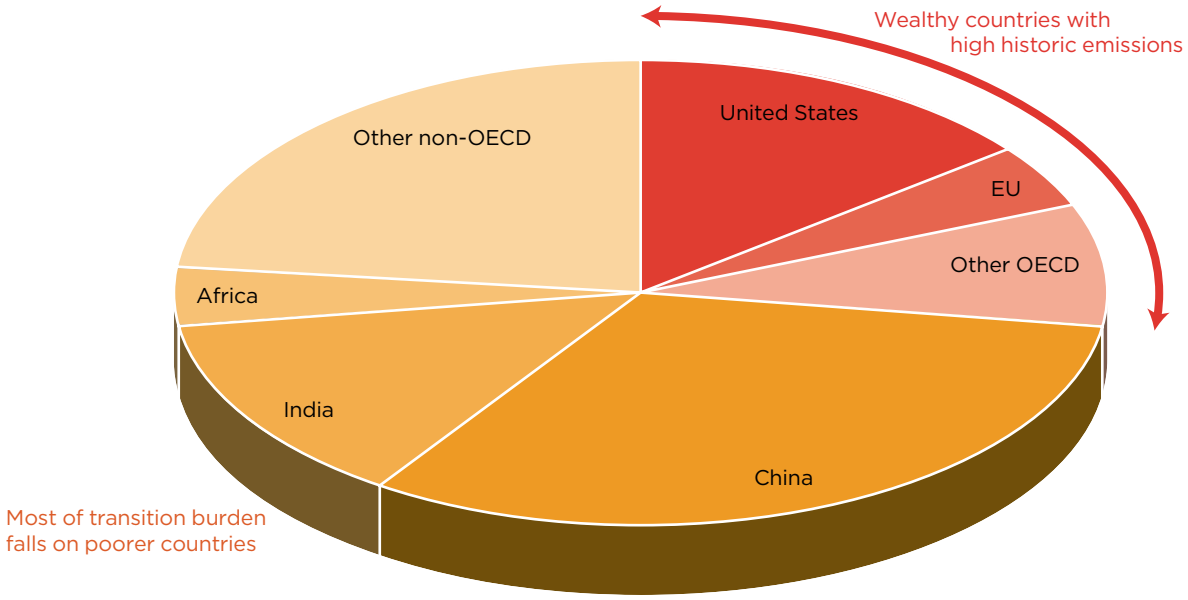
Sources: IEA, IPCC, Global Carbon Project[7]

Figure ES-3: IEA Sustainable Development Scenario Emissions, Compared to 450 Scenario



Source: IEA[8]

Figure ES-4: 2040 Emissions Cuts in Sustainable Development Scenario Compared to New Policies Scenario, OECD vs non-OECD countries



Source: IEA[9]

CALLING FOR MORE FOSSIL FUELS

While the IEA rightly advocates for governments to do more on climate change, it is concurrently undermining the energy transition by advocating for more investment in fossil fuel supply. The IEA makes these investment recommendations despite its own estimation that only one third of the world's fossil fuel reserves may be extracted without exceeding 2 degrees Celsius of warming.[10]

"Our message to the oil industry here in Houston is invest, invest, invest," said IEA Executive Director Fatih Birol in 2017, adding that the IEA does not foresee any coming peak in oil demand.[11]

In 2012, Birol (then the IEA's Chief Economist) said the world will need "every single drop of Canadian oil"[12] – a striking statement given that Canadian oil alone would exhaust 16 percent of the world's 1.5 degree carbon budget or 7 percent of the 2 degree budget, despite Canada having just 0.5 percent of the world's population.[13] In 2016, IEA Deputy Chief Economist Laura Cozzi added that while the United States' (U.S.) shale expansion will reduce its Canadian imports, "Many other places on the planet [will] continue to need Canadian oil."[14]

In 2014, as the world was beginning to turn away from coal, the IEA recommended that the United States enable greater transport of American coal to international markets, especially from the Powder River Basin to Asia via the Pacific Northwest.[15]

A 2017 IEA review of Norway's energy policies recommended, "If the government wants to maintain the level of resources and revenues, it must promote the exploration and production of oil and gas and increase recovery further."[16]

The World Bank Group announced in December 2017 that it will no longer finance upstream oil and gas after 2019, in order to "align its support to countries to meet their Paris goals."[17] In contrast, the IEA appears not to recognize the connection between fossil fuel supply and climate change.

In 2011, Birol warned that "the 'lock-in' of high-carbon infrastructure is making it harder and more expensive to meet our energy security and climate goals."[18] Once capital costs have been sunk, it becomes difficult for alternatives to compete economically, and perverse political incentives are created that prevent decision makers from admitting that a wrong decision was made. Birol was referring to infrastructure involved in consuming fossil fuels – such as power stations – but the same lock-in effects occur with infrastructure facilitating the supply of fossil fuels.

Previous research by Oil Change International has found that the committed emissions arising from already-producing oil fields, gas fields, and coal mines would be enough to take warming beyond 2 degrees, and those from already-developed oil and gas fields alone would take it beyond 1.5 degrees.[19] This implies that any new development of fields and mines could lead to lock-in of emissions beyond 2 degrees Celsius (and/or that existing assets will become fully stranded).[b] The IEA's advocacy for new fossil fuels is making it much harder to achieve the Paris goals.

b Note that existing fields and mines may continue to receive capital expenditure – such as in adding new wells or maintaining infrastructure. Thus additional capex (in Figure ES-1) does not necessarily imply new fields or mines will be developed.

A SELF-FULFILLING PROPHECY

Published every November, the IEA's flagship *World Energy Outlook* serves as a map of the future energy landscape until 2040, aiming to guide decisions on energy investments and policies. It is a map that leads to climate disaster.

The focus of the *WEO*, occupying about 80 percent of the report's narrative and almost all of the public communications, is on describing the New Policies Scenario (NPS), an energy future that would set the world on course for between 2.7 and 3.3 degrees Celsius of warming. Cumulative emissions from 2018 to 2040 in the NPS would exceed the limits corresponding to the Paris goals by between two and six times.[20]

The media, investors, corporations, and governments routinely use the NPS as a prediction of future demand for fossil fuels. As such, the NPS shapes decisions about investments and policies, including on some of the world's most polluting energy developments:[21]

- The NPS is helping enable massive expansion of **thermal coal mining in Australia**, by informing both supportive government policies and regulatory approval of new mines;
- The NPS provided a justification for the leasing program that opened the **Alaskan offshore Arctic Ocean to oil drilling**, as well as a defense used by oil lobby groups against public and investor opposition;
- The NPS informed policies to support greater investment in **Canada's tar sands**, was used in a government promotional campaign to tackle public opposition, and has been cited by oil companies justifying their tar sands plans to shareholders.

More indirectly, the IEA's central focus on the NPS feeds a general expectation that fossil fuel demand will keep rising, and even a moral argument to keep developing fossil fuels as a means to provide for energy needs. The NPS is also used as benchmark against which other energy forecasts – including those used directly in companies' decision making – are tested.

The IEA states publicly that the NPS is only a model's projection, rather than a prediction. We argue that the IEA must take responsibility for how its products are used in practice – in this case, being used to justify significant expansion of fossil fuel supply and endanger the climate. Indeed, the IEA encourages such usage by making the NPS the central focus of its communications, and by describing it as "our main scenario" which describes "where are we heading," informing people as to "how much more energy are we going to need."[22]

IGNORING THE PARIS GOALS

While the *WEO* focuses primarily on the NPS, in 2009 the IEA introduced a secondary "450 Scenario," to describe what the energy system would look like if governments achieved their then goal of limiting warming to 2 degrees Celsius. At the time, the 450S was a welcome innovation. But advances in climate science have revealed major risks associated with even 2 degrees of warming.

When the Paris Agreement consequently tightened the global goal to keeping warming "well below" 2 degrees and aiming for 1.5 degrees, the IEA did not update the ambition of its climate scenario. It had a good opportunity to do so when it replaced the 450S in 2017 with a new "Sustainable Development Scenario," which incorporated goals on universal energy access by 2030 and cutting air pollution due to its major health consequences. While the IEA says the SDS is aligned with the Paris goals, we find that in fact it follows the same emissions path as the 450S, which aimed to give only a 50 percent chance of keeping warming below 2 degrees.

The SDS is a poor guide to policymaking, as it does not reflect governments' climate goals.

This mismatch also exacerbates transition-related investment risk. Leading investors are increasingly asking companies about how their strategy accounts for climate change. The Task Force on Climate-Related Financial Disclosures, reporting to the Financial Stability Board of the G20, recommends testing the robustness of investments in a climate scenario.[23] Too often, such stress-tests use the SDS or 450S, failing to test against a scenario in which the world achieves the goals of the Paris Agreement.

Oil and gas companies say their investments fare well in these IEA scenarios, which is rather unsurprising given that the scenarios forecast demand for oil falling only 23 percent from current levels by 2040, and demand for gas increasing. This suggests the SDS provides too weak a stress test for investments, given that it does not expose stresses, and that it does not reflect the globally agreed level of ambition on climate mitigation.

TOWARDS PARIS-ALIGNED CLIMATE SCENARIOS

In 2017, the IEA published two new scenarios (outside the *WEO*), which would give a 66 percent probability of keeping warming below 2 degrees Celsius: the Faster Transitions Scenario (FTS) and the Beyond 2 Degrees Scenario (B2DS).

These are a welcome step in the right direction, but they cannot be seen to be fully aligned with the Paris goals. Not only do both scenarios ignore the goal of 1.5 degrees Celsius, their one-in-three odds of exceeding 2 degrees constitute an uncomfortably high level of risk, and certainly do not match the current understanding of a "defense line that needs to be stringently defended."[24]

Furthermore, both scenarios rely on the availability of unproven technologies such as carbon capture and storage or negative emissions. If successful, such technologies may help humanity

reduce warming further than would otherwise be possible. But given that we do not know whether they will become available, we must not predicate avoiding the dangers above 2 degrees Celsius on their invention. We argue that scenarios should be transparent about how they would look if those technologies do not become available.

We propose two alternative approaches to aligning scenarios with the Paris goals:

- A single scenario with a high probability (say, 80 or 90 percent) of keeping warming below 2 degrees Celsius, reflecting the notion of "stringent defense"; or

- Two scenarios: one with modest probability (say, 66 percent) of keeping warming below 2 degrees and the other with 50 percent probability of keeping below 1.5 degrees – the aim of energy decisions should then be to keep emissions as far as possible below the 2 degrees scenario, and as close as possible to the 1.5 degrees scenario.

The IEA started developing a 1.5 degrees scenario in 2016, but apart from a very brief mention in *WEO 2016* (with no data), that scenario has not been published, and was not even mentioned in *WEO 2017*.

A FOSSIL FUEL LEGACY

The IEA has its roots in oil-consuming countries' response to the oil price shock of 1973 and 1974. Since then, it has evolved beyond oil to encompass all aspects of the energy system. Today it plays an important role in facilitating world-leading technological development, including in renewable energy and energy efficiency, by bringing researchers together, documenting progress, and identifying gaps.

However, in the present day the IEA appears torn between its historic objective of ensuring fossil fuel supplies and the newer priority of addressing climate change. This conflict is reflected in the IEA calling for more investment in fossil fuels and their supply infrastructure, to an extent that would undermine efforts on climate change. The IEA also continues to promote fossil fuel consumption through a Clean Coal Centre and coordinates development of technologies that make fossil fuels more competitive compared to clean energy. In the words of Hermann Scheer, one of the founders of the International Renewable Energy Agency, the IEA 'leaves no stone unturned when it comes to emphasizing the long-term indispensability of nuclear and fossil energy.'[25]

The fossil fuel industry has extensive influence over the IEA and especially the *WEO*, undermining the impartiality of its information. As an intergovernmental organization, the IEA formally answers to its member governments, but their governance meetings – at both ministerial and civil servant level – are also attended by the Energy Business Council, consisting mainly of corporations with fossil fuel interests. The IEA maintains a direct channel to the coal industry through a Coal Industry Advisory Board (CIAB), a structure that looks increasingly anachronistic.

A number of analysts have critiqued the technical quality of the IEA's modeling. Studies have pointed out that the IEA's forecasts in the NPS of renewable energy growth have been systematically inaccurate, repeatedly projecting a stagnation or even decline of the renewable energy industry, while in fact its growth has followed an exponential path.[26] Part of the reason is that the IEA's modeling approach is vulnerable to groupthink and subject to an inherent conservatism that fails to properly evaluate technology disruption. While this report focuses instead on the structure, aims, and usage of the *WEO*, we note that this forecasting failure raises further questions about the value of a business-as-usual scenario like the NPS as a planning tool for policy and investment.

RECOMMENDATIONS

The depth of technical knowledge in the IEA is considerable, but we argue it should be deployed in a more balanced, forward-looking way. As an intergovernmental agency, the IEA should be helping governments achieve their stated climate goals, not hindering them. We recommend that the IEA change the balance of the *WEO*, and the definition of its climate scenario, as follows:

- **Plan for Success:** Focus the *WEO* on showing governments what is needed to achieve policy goals, making the climate scenario the central one instead of the business-as-usual NPS.

- **Respect Paris Goals:** Align the climate scenario with the Paris Agreement goals of keeping warming *well below* 2 degrees Celsius (with high probability) and pursuing efforts to keep it to 1.5 degrees, with full transparency about assumptions.

- **Highlight Gaps:** Make the NPS a secondary, comparative scenario – explicitly to show where action is needed.

The IEA is one of the few institutions with the required expertise, credibility, and scope to create the tools needed to plan for our energy future and meet our climate goals. Aligning IEA analysis with the stated climate goals of its members is critical to energy policy and financial decision making.

We therefore recommend that governments and investors engage with the IEA to advocate for it to light the way to a clean energy future.

CONTENTS

ABBREVIATIONS

1.5S	1.5 degrees Celsius Scenario
66S	66 percent chance at 2 degrees Celsius Scenario
B2DS	Beyond 2 Degrees Scenario
bn bbl	billion barrels
BNEF	Bloomberg New Energy Finance
°C	degrees Celsius
CCS	carbon capture and storage
CEO	chief executive officer
CIAB	Coal Industry Advisory Board
CO_2	carbon dioxide
CPS	Current Policies Scenario
EBC	Energy Business Council
EIA	(U.S.) Energy Information Administration
ETP	*Energy Technology Perspectives* report
FTS	Faster Transition Scenario
Gt	gigatonne (one billion metric tonnes)
GW	gigawatt (one billion watts)
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
kcf	thousand cubic feet
LCOE	levelized cost of energy
LNG	liquefied natural gas
Mt	megatonne (one million metric tonnes)
MWh	megawatt-hour
NDC	nationally determined contribution
NPS	New Policies Scenario
OECD	Organisation for Economic Cooperation and Development
OPEC	Organization of the Petroleum Exporting Countries
SDS	Sustainable Development Scenario
tcf	trillion cubic feet
UNFCCC	United Nations Framework Convention on Climate Change
WEO	*World Energy Outlook*

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SCENARIOS DISCUSSED IN THIS REPORT

A scenario is a description of the future, defined by a set of assumptions – for example, assumptions about politics, economics, or technology. Since we do not know what the future holds, we can only talk about the future by making such assumptions.

Commonly, the function of scenarios is not to predict the future, but to examine how different aspects of it may be influenced by certain factors, usually through use of a quantitative model.

Name	Abbreviation	Definition / Key Assumptions[c]	50% Probability of Limiting Warming to	Status
Main Foci of this Report:				
New Policies Scenario	NPS	Governments implement (most of) the policies they have already announced, and no more	3°C (see page 18)	The main scenario in the World Energy Outlook
Sustainable Development Scenario	SDS	Governments implement policies sufficient to achieve Sustainable Development Goals on climate, energy access, and air pollution (though not to achieve the Paris goals of 1.5°C or well below 2°C)	2°C (see page 24)	1 of 2 secondary *WEO* scenarios (since 2017)
Other IEA Climate Scenarios:				
450 Scenario	450S	Policies introduced sufficient to achieve 50% probability of staying below 2°C	2°C	Obsolete – Until 2016 was 1 of 2 secondary *WEO* scenarios
Faster Transition Scenario (aka 66% 2°C Scenario)	FTS	Policies introduced sufficient to achieve 66% probability of staying below 2°C	1.75°C (see page 28)	One-off scenario published in standalone publication in March 2017, but appears briefly in *WEO* 2017, with limited data
1.5°C Scenario	1.5S	Policies introduced sufficient to achieve 50% probability of staying below 1.5°C	1.5°C	Briefly mentioned in *WEO* 2016 with no significant data
Beyond 2 Degrees Scenario	B2DS	Policies sufficient to achieve 2°C (50% probability), plus further technology improvements and deployment pushed to max potential	1.75°C (see page 28)	Introduced in 2017 as a secondary scenario in the IEA's annual *Energy Technology Perspectives (ETP)* report
Other IEA Scenarios:				
Current Policies Scenario	CPS	No new policies beyond those already in force	Extreme	1 of 2 secondary *WEO* scenarios
Reference Technology Scenario	RTS	Current commitments	2.7°C	One of the two main scenarios published every year in *ETP*
2 Degrees Scenario	2DS	Policies introduced sufficient to achieve 50% probability of staying below 2°C	2°C	One of the two main scenarios published every year in *ETP*

We also occasionally refer in this report to IPCC Scenarios, developed by different scientific teams. Hundreds of scenarios were used in the IPCC's Fifth Assessment Report, which was published in 2013 and 2014. Thus far, dozens have been developed for the Sixth Assessment Report; summaries exist in database form at https://tntcat.iiasa.ac.at/SspDb/.

c IEA scenarios also contain assumptions about population growth, economic growth etc.

1. INTRODUCING THE IEA

The International Energy Agency is the world's most influential source of energy information. It aims to support energy management, policy and investment decisions in its 30 member countries and in the private sector, "to ensure reliable, affordable and clean energy."[27]

The IEA was founded in response to the oil price shock of 1973 and 1974, to increase oil-importing countries' resilience against future shocks, overseeing and coordinating the maintenance of strategic reserves. It aimed to serve as a counterpoint to the Organization of the Petroleum Exporting Countries (OPEC), which was then in its prime.

Since then, the IEA's activities have broadened considerably, to encompass all aspects of energy, although security of supply remains at the heart of its priorities.[28] Today the IEA also advises governments on energy policies, publishes energy statistics and forecasts, and convenes discussions among industry and governments. Governments, companies, and investors rely on IEA information to inform their decisions about policies, technologies, and investments.

While membership is limited to industrialized countries in the Organisation for Economic Cooperation and Development (OECD), the IEA is increasingly reaching out to the rising powers of the Global South. Reflecting the dramatically different growth profiles of OECD vs non-OECD countries and the increasing global leadership roles of China and India, the IEA recently introduced a category of associate membership, now held by Brazil, China, India, Indonesia, Morocco, Singapore, and Thailand.

Flags of IEA member countries

CLIMATE CHANGE

The most pressing energy issue of the 21st century is how to avoid dangerous climate change. Failure to avert significant warming would lead to major damage to human health, destruction of infrastructure, disruption of food supplies, mass migration, economic destabilization, and an acceleration in the loss of biodiversity.[29]

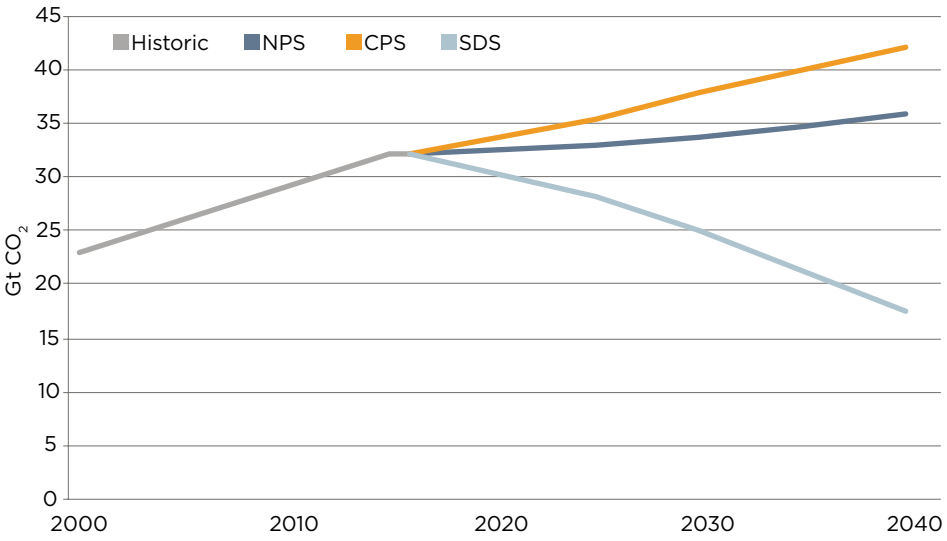
All of the IEA's member countries have signed the Paris Agreement, and all except Turkey have ratified it,[d] committing to keeping warming to "well below" 2 degrees Celsius and aiming to keep it to 1.5 degrees Celsius. The problem is urgent. The carbon budget for a 50 percent probability of keeping warming to 1.5 degrees Celsius will be exhausted within eight years at current rates; the budget for a 66 percent chance of staying below 2 degrees Celsius within nineteen years.[30]

Fossil fuels are responsible for 85 percent of the world's carbon dioxide (CO_2) emissions and 64 percent of total greenhouse gas emissions.[31] Governments need urgent guidance to transform their energy systems away from both the production and consumption of fossil fuels. The world needs advocates to push governments and companies to do what is needed.

One of the IEA's stated aims is to "promote sustainable energy policies that spur

d The United States (an IEA member) announced in 2017 its intention to withdraw from the Paris Agreement, which has been signed by all of the countries of the world. The withdrawal cannot take effect until November 4, 2020. The rejectionism of the current U.S. administration appears to have strengthened the resolve of other countries on climate change.

Figure 1: Energy Emissions in WEO 2017 Scenarios



Source: IEA[34]

economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse gas emissions that contribute to climate change."[32] Today, the IEA's activities increasingly focus on climate change, and many of the IEA staff are specialists in renewable energy, energy efficiency, and environmental economics. At the same time, the organization's focus on energy security – by which the IEA generally means maintaining a comfortable excess of supply over demand for the largest fuels – often pull in the opposite direction, creating a justification for protecting the supplies of fossil fuels and the associated rail, pipeline, port, and shipping infrastructure at the expense of the transition to clean energy.

THE WORLD ENERGY OUTLOOK

The IEA is now best known for its flagship report, the *World Energy Outlook* (*WEO*), published every November. This 700-page report projects the future of energy demand and supply for roughly the next 25 years (currently to 2040), in order to provide policymakers, industry, and other stakeholders with the data, analysis, and insights needed to make sound energy decisions.

The *WEO*'s projections are generated using the IEA's World Energy Model, which aims to simulate the functioning of the energy system based on historical trends and assumptions about policy, demographic and economic trends, and technology. The *WEO* focuses primarily on one main baseline scenario:

- **New Policies Scenario:** assumes the continuation of current policies and the "cautious implementation"[33] of intended policies that have been announced.

It also has two secondary scenarios with different assumptions about government action on energy and climate change:

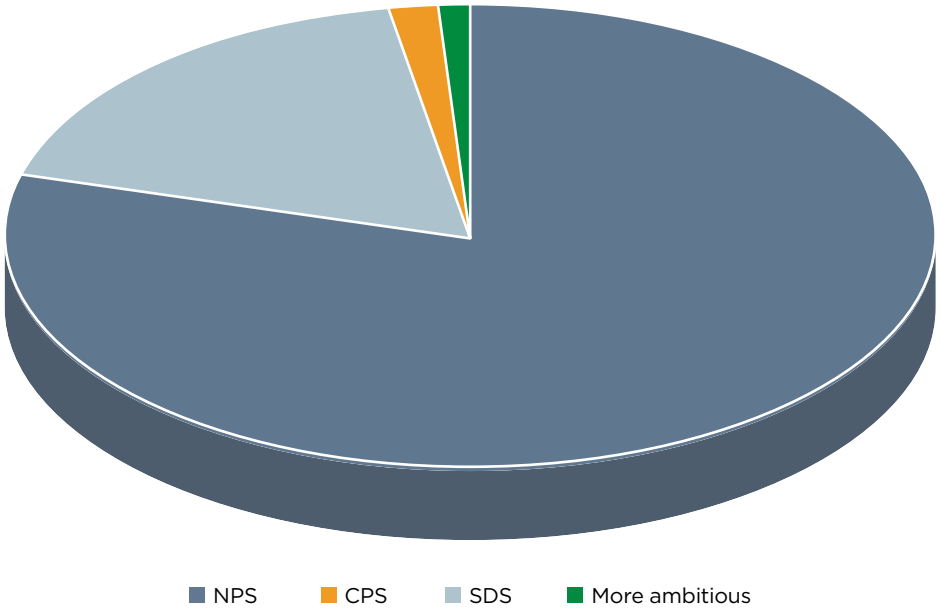
- **Current Policies Scenario (CPS):** assumes no new policies are introduced.
- **Sustainable Development Scenario:** assumes governments succeed in achieving climate, air pollution, and access-to-energy goals as expressed in the Sustainable Development Goals[e] (although as we find in Section 4, the IEA fails to correctly interpret the climate goals).

The three scenarios lead to different amounts of emissions, as shown in Figure 1, and hence different amounts of climate change.

The NPS occupies about 80 percent of the narrative discussion in the *WEO* (Figure 2), is more fully characterized in the data tables, and is the primary subject of media and communication efforts. The CPS and SDS are explored less thoroughly in both narrative and data tables and barely mentioned in press releases. A few other scenarios are touched on very briefly in the narrative, but with no significant data projections.[f]

This report examines the NPS and the SDS. The third scenario, the CPS, is not explored in depth (for a summary of these and other scenarios used by the IEA, see page 12).

Figure 2: Pages of Narrative Devoted to Each Scenario in WEO 2017



Source: IEA[35]

e SDG 13, 3.9, and 7 respectively
f Such as the Faster Transition Scenario and the Low Oil Price Case

BENCHMARK FOR ENERGY FUTURES

In addition to the IEA, the U.S. Energy Information Administration (EIA), ExxonMobil, Shell, BP, Statoil, and OPEC also regularly publish energy forecasts. Outside the U.S. (where EIA tends to be the most used), the IEA is the most respected of the energy forecasters and often the benchmark against which the others are measured. For example, in response to shareholders' concerns about climate risk, ExxonMobil argued that its portfolio would not be threatened, citing its own Energy Outlooks, pointing out that they gave comparable projections to the IEA's NPS, and stating that new oil and gas investment would be required in both the NPS and the 450S.[36]

These different projections are broadly aligned, all forecasting an increase in global primary energy demand of around 30 percent by 2040, with the vast majority of supply coming from fossil fuels. Forecasters tend to take comfort in the similarity of their results, although this could alternatively be seen as a symptom of groupthink.[37]

All of the main forecasters have been criticized for consistently projecting slowdowns in renewable energy, even as installation growth and price deflation have accelerated (see page 23). Partly in response, newer forecasters have arisen specializing in clean energy (including storage and energy efficiency), such as Bloomberg New Energy Finance (BNEF) and the International Renewable Energy Agency (IRENA), which often consider the possibility of greater technological disruption.

STRUCTURE OF THIS REPORT

In Section 2 of this report, we review some real world cases where the IEA advocates for – and the *WEO* is used in justification of – new fossil fuel development, including in some highly controversial cases.

In Section 3, we examine the implications of the NPS and discuss how it tends to shape the energy system.

In Section 4, we turn to the implications of the SDS and its predecessor 450 Scenario, and consider their use in investment decisions, especially in light of the recommendations of the Task Force on Climate-Related Financial Disclosures.

In Section 5, we calculate oil and gas investment implications of the NPS and SDS, compared with investment levels that would be aligned with the Paris goals.

In Section 6, we explore the political dynamics shaping the IEA, including industry influences, competing objectives, and countries' interests.

Finally, in Section 7 we make recommendations for reform and modernization of the *WEO*, and ultimately of the IEA itself.

BOX 1: What the IEA Gets Right

This report focuses on the IEA's negative impact on climate change, especially through the *World Energy Outlook*. However, the IEA also carries out several positive activities that aim to help address climate change.[38] The depth of technical knowledge in the IEA is considerable, but we argue it should be deployed in a more balanced, forward-looking way, especially in the IEA's highest-profile activities.

The IEA plays an important role in facilitating and documenting world-leading technological development, including in renewable energy and energy efficiency (although also in fossil fuels – *see page 35*). For example, the IEA convenes technology cooperation programs which bring together researchers and users to advance the research, development, and commercialization of new technologies, through sharing of information, cross-fertilization, producing common technical standards, enabling pilot projects, and so on.[g,39] The IEA publishes "technology roadmaps" to monitor progress, identify obstacles, and facilitate next steps.

The annual *Energy Technology Perspectives* report explores key technological trends and potential. It is developed by a different team than the *WEO*, uses a different model,[h] and serves a different purpose: It informs technological development, policy, and strategy, rather than broad energy policy and investment. It has a particular focus on clean energy, including efficiency and flexibility. The *ETP* tends to consider different futures that may disrupt the status quo. In 2017, it published a Beyond 2 degrees Scenario, with the aim of limiting warming to 1.75°C.

The *WEO* has also sometimes played a positive role on climate. In 2009, it introduced the 450 Scenario to illustrate a potential pathway to limit warming to 2 degrees Celsius. This scenario set an important precedent and became a valuable tool, although unfortunately the IEA has failed to upgrade the ambition of this scenario to keep track with revised scientific understanding, greater-than-expected renewable energy trends, and stronger political goals. In 2015, a *WEO* special report helpfully tracked the impact of countries' emission pledges in the run-up to the Paris Agreement and proposed five low-cost, short-term policy measures that could close the gap and keep long-term temperature goals within reach.[40]

At times, the IEA has advocated for stronger action on climate change. In 2011, Fatih Birol, who was then the IEA's Chief Economist, said, "I am very worried – if we don't change direction now on how we use energy, we will end up beyond what scientists tell us is the minimum [for safety]. The door will be closed forever."[41] However, as we shall see in the next section, the IEA has encouraged the very decisions that are helping close the door.

g In 2016, participation in technology cooperation programs consisted of 38 percent efficiency, 24 percent renewable energy and hydrogen, 11 percent fossil fuels, 22 percent fusion, and 5 percent cross-cutting.
h This separation is largely an historical artefact: The ETP was originally commissioned by the G8 group of countries, following the 2005 meeting at Gleneagles, Scotland. There has since been talk of merging the WEO and ETP teams.

2. DRIVING FOSSIL FUEL EXPANSION

"Our message to the oil industry here in Houston is invest, invest, invest," said IEA Executive Director Fatih Birol in March 2017. He added that the IEA does not foresee any peak in oil demand.[42]

In 2012, Birol said the world will need "every single drop of Canadian oil,"[43] a striking statement given Canada's vast reserves: Canadian oil alone could exhaust 16 percent of the 1.5-degree Celsius carbon budget or 7 percent of the 2-degree Celsius budget[44] (from a country with 0.5 percent of the world's population). In 2014, Birol added that "Canadian production will be a very important cornerstone of the security of global oil markets."[45] In 2016, IEA Deputy Chief Economist Laura Cozzi added that while U.S. shale expansion will reduce its Canadian imports, "There [are] going to be many other places on the planet that continue to need Canadian oil. It's just that the destination may be different."[46]

In Oslo in 2016, Birol reportedly said "the world [will] need every drop of Norwegian oil," a point that was cited by Norway's government in the growing national debate about whether to restrict Norwegian production in order to achieve climate goals.[47]

On a five-yearly cycle, the IEA publishes reviews of member countries' energy policies. These reviews often call for more policy support for fossil fuels, despite the climate impacts. For example, in the IEA's 2017 review of Norway: "To date, only one-third of the gas resources and half of the oil resources have been produced in Norway, but the rate of production by field has been decreasing since 2006. This means that if the government wants to maintain the level of resources and revenues, it must promote the exploration and production of oil and gas and increase recovery further."[48] One area of Norway is currently closed to oil drilling: the sensitive Lofoten-Vesterålen-Senja area in the northwest, which is important for both fishing and tourism. The 2005 version of the IEA review urged Norway to open the area to drilling; the 2011 edition called for the decision to be expedited.[49]

The IEA also advocates in the country reviews for government approval of investment in fossil fuel transportation infrastructure in its country reviews, in addition to investments in extraction. In 2014, as the world was beginning to turn away from coal, the IEA recommended that the U.S. enable greater transport of American coal to international markets, especially from the Powder River Basin to Asia via the Pacific Northwest.[50] The following year, it called on Canada to build more oil pipelines and liquefied natural gas terminals.[51]

The IEA is not unaware of the climate implications. The *WEO 2012* estimated that only a third of the world's fossil fuel reserves could be extracted while aiming for 2 degrees Celsius of warming.[52] Yet the IEA continues to call for more fossil fuel investment.

Contrast this with the World Bank Group, another intergovernmental organization with unique international expertise and a strong concern about climate change. In December 2017, the Bank announced that it will no longer finance upstream oil and gas after 2019, in order to "align its support to countries to meet their Paris goals." Whereas the IEA seems unable to perceive a cognitive dissonance between advocating for more fossil fuel supply and for reduced emissions, the World Bank Group took decisive action. We shall explore the full impacts of this contradiction in Section 3.

WORLD ENERGY OUTLOOK – THREE CASE STUDIES OF HOW IT IS USED

In this section, we examine case studies of how the *WEO* has been used to justify and enable three highly controversial fossil fuel developments.

Australian Coal Mines

The Galilee Basin in Queensland is one of the world's largest untapped deposits of coal. Mining companies are looking to build nine huge new mines, whose combined peak production of 330 megatonnes (Mt) of coal per year would lead to 705 Mt of CO_2 emissions. If these mines were a country, it would be the world's seventh-largest emitter.[53] As development plans were being made for the basin in 2010, the Queensland government formulated its *Coal Plan 2030* on how to help facilitate full development of the coal,[54] drawing strongly on *WEO* forecasts of rising Asian coal demand. Those forecasts also informed supportive policies in Australia's federal Energy White Papers in 2012 and 2015.[55]

Adani's proposed Carmichael coal mine is the largest of the nine mines and with a project life of up to 90 years, could keep the coal flowing long after the world needs to have reduced emissions to zero. In its permit application, Adani proposed rising demand in India and China as the rationale for the project,[56] citing the federal government's *Australian Energy Resources Assessment*, whose forecasts were based on the *WEO*'s.[57] When the Queensland Land Court reviewed the application and objections to it, Adani's expert witness relied on the NPS forecasts of Chinese and Indian coal consumption as justification for the project. The judge accepted the IEA as a credible source and recommended government approval of the project, which was subsequently granted.[58] Australian Energy Minister Josh Frydenberg commented on the approval by saying that there is a "strong moral case" for coal to relieve energy poverty (a misconceived argument, as demonstrated by ODI, Christian Aid, and CAFOD, among others[59]), citing the NPS forecast of increased global fossil fuel consumption by 2040.[60] However, facing growing climate-related concerns from

investors and widespread civil society resistance, Adani has so far struggled to garner sufficient support to close on the project.

Arctic Oil Exploration

In the early 2010s, scientific studies of carbon budgets found that existing fossil fuel reserves significantly exceeded what the world could afford to burn within climate limits,[61] a recognition that gradually filtered into policy circles, including in the IEA. Even when faced with too much oil, the oil industry wanted to explore ever further north for new arctic reserves; in a sad irony, it sought to take advantage of the fact that melting ice was making new resources accessible.

The U.S. Bureau of Ocean Energy Management used *WEO* (NPS) forecasts of U.S. and global energy demand, as well as those of the EIA, as justification for its 2012-17 Outer Continental Shelf oil leasing program, which included arctic Alaska.[62] Lisa Murkowski, chair of the U.S. Senate Energy Committee and a lead advocate of increased oil drilling onshore and offshore Alaska, repeatedly brought up the *WEO*'s demand forecasts and invited the IEA to present to her committee.[63] As U.S. regulators began to respond to rising public concern, oil industry lobby groups pointed to the NPS forecast, arguing that arctic oil was crucial to meeting rising demand.[64] And when a parliamentary committee in the UK argued that support for arctic oil drilling was inconsistent with keeping warming to 2 degrees Celsius, the UK government responded that oil demand levels projected in the IEA's 450 Scenario would require arctic supply among others.[65]

At the height of the controversy over its plans to drill in waters off Alaska, Shell argued that increased future energy demand made the plans necessary,[66] citing the *WEO* to corroborate its own forecasts.[67] Shell ultimately abandoned its project, faced with mounting public opposition, an investor revolt, and disappointing test well results, and most companies are showing little interest in Alaska for now. In Norway, though, companies are pushing ever further north in the Barents Sea, using many of the same arguments as in Alaska, and likewise citing the *WEO*'s demand forecasts.[68]

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Canadian Tar Sands

Canada's vast oil reserves – primarily the tar sands of Alberta – would exhaust 7 percent of the world's 2-degree Celsius carbon budget or 16 percent of the 1.5-degree Celsius budget.[69] As climate scientist James Hansen put it, extracting the tar sands would mean "game over" for the climate.[70] A study in *Nature* found that, based on an assumption that the lowest-cost fossil fuel resources will be the ones extracted, 99 percent of Canada's tar sands would be left in the ground in a world where warming is kept below 2 degrees Celsius.[71]

However, companies such as Suncor and Imperial Oil have used the *WEO* (NPS) demand forecast to argue that the extra oil will be "needed," justifying to shareholders their ongoing investment in expansion.[72] During the tar sands boom over the past decade, while the oil price was above $100, Canada's then federal natural resources minister repeatedly cited *WEO* forecasts of rising demand, especially in Asia, as an important opportunity for Canada, leading the government to encourage foreign investment in the sector.[73] Faced with increasing opposition from environmentalists, scientists, and First Nations, in 2013 the federal government ran a promotional campaign for tar sands expansion, including a series of public leaflets and factsheets which used *WEO* demand forecasts to argue that oil from the tar sands would be needed and therefore would boost the Canadian economy, provide the U.S. with secure supplies, and foster energy innovations.[74]

The key to expansion of the landlocked tar sands is the construction of new pipelines, which has become the most debated environmental issue in Canada. Every year the Canadian Association of Petroleum Producers publishes a report on markets and transportation for Canadian oil, whose main purpose is to lobby for more pipelines. Each report relies on the *WEO* forecast to argue that Asian oil demand will grow quickly, justifying further expansion of the tar sands and thus new pipelines.[75] In contributing to regulatory approval processes for pipelines, the Environment and Climate Change Canada ministry has turned to the IEA's 450 Scenario, finding that tar sands oil would be needed even in a world that limits climate change to 2 degrees Celsius.[76] The National Energy Board's (NEB) recommendation for approval of the controversial Kinder Morgan pipeline through British Columbia[i] rested on the public benefit of diversifying markets to Asia,[77] which it judged using the NPS demand forecasts.[78] What may not have been clear to the NEB is that those forecasts would lead the world along the path toward climate disaster, as we shall see in the next section.

i Today Kinder Morgan is trying to build the pipeline but facing legal obstacles from the British Columbia government and First Nations, and extensive public opposition.

3. A SELF-FULFILLING PROPHECY: THE NEW POLICIES SCENARIO

The IEA's *World Energy Outlook* aims to be "used by public and private sector stakeholders as a framework for policy-making, planning and investment decisions."[79]

As we saw in the previous section, governments, companies, and investors rely on *WEO* forecasts of future energy demand in making decisions on new investments in energy infrastructure, particularly with respect to exploration and development of new fossil fuel basins. After all, when committing billions of dollars to a project that may last decades, decision makers want to know whether there will still be a need for the project throughout its life, and whether it is likely to be profitable. It is usually the New Policies Scenario (NPS) to which they turn, which forecasts ever-increasing demand for fossil fuels, as shown in Figure 3.

PATHWAY TO CLIMATE DISASTER

What would be the climate consequences if the future turns out like the NPS?

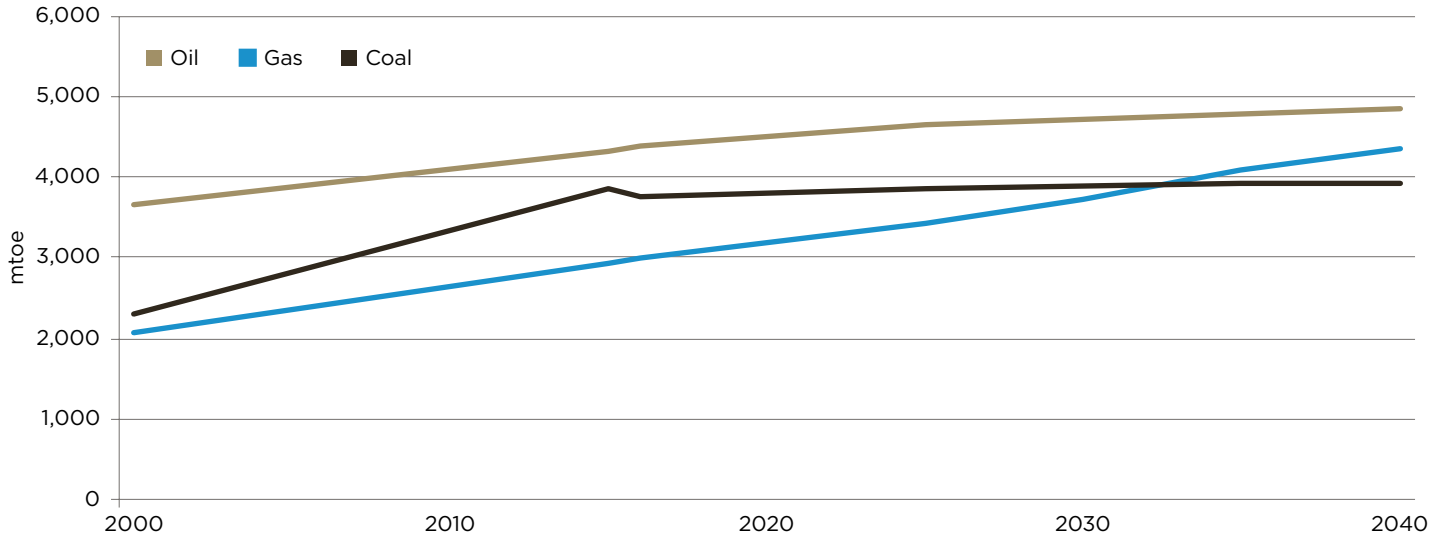
The Paris goals are to keep warming well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to keep it to 1.5 degrees Celsius. This represents a range of targets from 1.5 to 2 degrees Celsius, with a preference to arrive at the lower end of the range.

To compare emissions under the NPS with the Paris goals, we represent the goals using the IPCC's carbon budgets for a 66 percent probability of keeping warming below 2°C and a 50 percent probability of keeping it below 1.5°C. Energy decisions should then ensure that emissions are as far as possible below the 2°C budget, and as close as possible to the 1.5°C budget.[81]

Assuming non-energy emissions of 180 Gt CO_2 over the rest of the century, that leaves respectively 580 and 130 Gt CO_2 as of start of 2018, as the budgets for energy emissions alone.[j] We allocate 70 percent of the 2-degree budget (406 Gt) to the period 2018-40, and all of the 1.5-degree budget. On a precautionary basis, we assume that negative emissions technologies other than afforestation will not be available, as to date they exist only in theoretical models *(see Box 3, page 27)*.

Cumulative emissions from 2018 to 2040 under the NPS are compared with the Paris goals in Figure 4.

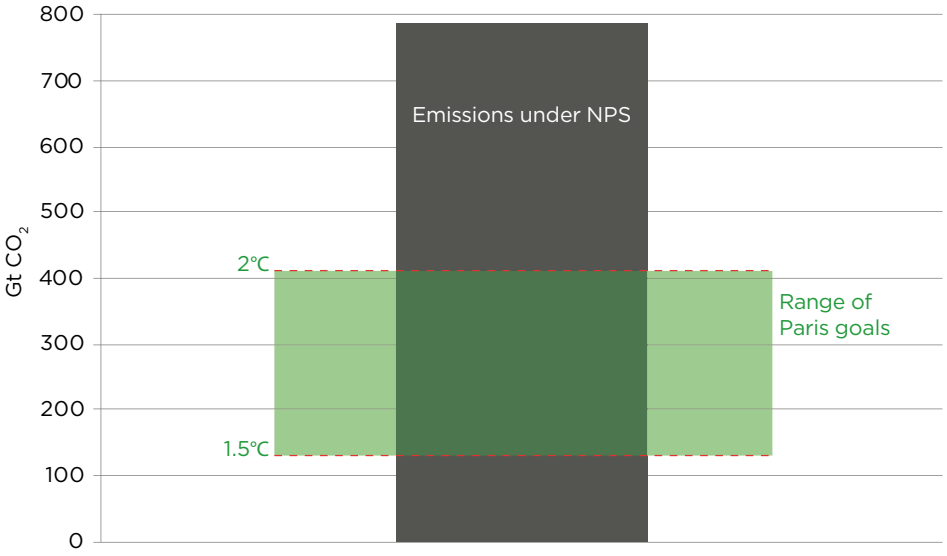
Figure 3: Oil, Gas, and Coal Primary Demand in NPS, *WEO 2017*



Source: IEA[80]

j These probabilities still reflect a high degree of risk, relative to the dangers at and beyond 2°C. They are used because the IPCC typically characterizes outcomes with probabilities of 33, 50 or 66 percent.

Figure 4: Cumulative 2018-40 Emissions in the *WEO* (NPS), Compared to Paris Goals



Sources: IEA, IPCC[82]

We see that emissions under the NPS are between two and six times the limits implied by the Paris goals. Under the NPS, the 1.5-degree Celsius budget would be exhausted by 2022 and the (full-century) 2-degree Celsius budget would be exhausted by 2034. Following the NPS would thus make achieving the Paris goals impossible (unless technology were invented that could extract quite massive quantities of carbon dioxide from the atmosphere – *see page 27*).

How much warming would the NPS lead to? Since the NPS forecasts only energy emissions, and only until 2040, any estimate depends on assumptions about non-energy emissions and about what happens after 2040. The IEA estimates that the NPS would set the world on course towards 2.7 degrees Celsius of warming by the end of the century.[83] However, this may be a rather hopeful estimate. The NPS assumes countries deliver on most but not all of their NDCs,[84] which collectively have been estimated to set the world on course for warming of between 2.8 and 3.3 degrees Celsius – implying that the NPS could lead to 3 degrees Celsius or more.[85]

According to the IPCC Fifth Assessment Report, 3 degrees Celsius of warming would lead to extensive biodiversity loss, with high risk of "abrupt and irreversible changes" in physical systems.[86] It would disrupt food production, significantly reducing maize, wheat, and rice yields.[87] 17 percent of the global population would experience a severe reduction in water resources.[88] The U.S. National Academy of Sciences estimates that in general, each degree Celsius of warming can be expected to produce:[89]

- 5 to 10 percent changes in precipitation across many regions;
- 3 to 10 percent increases in the amount of rain falling during the heaviest precipitation events;
- 5 to 10 percent changes in streamflow across many river basins;
- 5 to 15 percent reductions in the yields of crops as currently grown; and
- 200 to 400 percent increases in the area burned by wildfire in parts of the western U.S.

Professor Anders Levermann of the Potsdam Institute for Climate Change Research summarizes: "Beyond two degrees of warming we are leaving the world as we know it."[90]

As for investments, Warren Buffett's letter to shareholders in February 2018 warns of the real and growing risk of a USD 400 billion extreme weather event year in the U.S. and the lack of insurance industry preparedness for such a capital loss situation. This comes after he estimates the 2017 insurance industry hurricane losses in the U.S. were of the order of USD 100 billion, with a USD 3 billion loss incurred by Berkshire Hathaway alone.[91]

LOCKING IN EMISSIONS

As we saw in the previous section's case studies, the demand projections of the NPS – which would cause potentially catastrophic amounts of climate change – play a key role in shaping energy decisions. The projections inform government policies to support new fossil fuel development. They persuade regulators to approve mines, fields, and infrastructure. Companies use them to justify investments to their shareholders. And faced with public debate on climate impacts and mounting public opposition to fossil fuel expansion, governments and companies point to the IEA's projections to defend the developments.

Indirectly, fossil fuel companies use the NPS as a benchmark to test their own scenarios, which they use in making internal decisions. Furthermore, by presenting a picture of the future in which fossil fuels continue to dominate, the NPS tends to reinforce a fatalism among decision makers that fossil fuels' centrality is inevitable. "Fossil fuel fatalism" distracts from the scale of transition that is needed to combat climate change. This fatalism among policymakers and investors – that the problem cannot or will not be solved – provides an excuse for inaction and a basis for cognitive dissonance. The forecast has a "magnetic pull," as Nigel Topping of the We Mean Business coalition puts it.[92] This fatalism and pull are convenient for fossil fuel companies: Shell, for example, has used the scenario to infer that governments are unlikely to meet their climate goals.[93]

The problem is that these policies and investments help to make the projections come true: They become a self-fulfilling prophecy. Once fossil investments have been made, it becomes more difficult for clean energy sources to compete with them. In 2011, Fatih Birol (then the IEA's Chief Economist, now Executive Director) warned that "the 'lock-in' of high-carbon infrastructure is making it harder and more expensive to meet our energy security and climate goals."[94] Birol was referring to infrastructure involved in consuming fossil fuels, such as power stations, factories,

and inefficient buildings. However, the same lock-in effects occur with fossil fuel supply infrastructure.

In a wide-ranging study of carbon lock-in, Yale professor Karen Seto and colleagues explain:[95]

> *The current global energy system is the largest network of infrastructure ever built, reflecting tens of trillions of dollars of assets and two centuries of technological evolution, and is supported by an equally extensive complex of coevolved institutions, policies, and consumer preferences [...] The inertia of technologies, institutions, and behaviors individually and interactively limit the rate of such systemic transformations.*

Seto's group examines three dimensions of lock-in:

- Infrastructural: Long-lived infrastructure operates for multiple decades;
- Institutional: Organizations use their power and resources to preserve the status quo; and
- Behavioral: Cultural norms perpetuate individual and social behaviors and habits.

Once capital has been sunk into infrastructure, it will be in the operator's economic interest to continue operating as long as they can sell the product for more than the marginal cost of producing it – even if that entails making a long-term loss on the investment – since closing down would lead to an even greater loss. As the *WEO 2011* says of downstream (fossil fuel consumption) infrastructure, "it would be inordinately expensive to retire early or to retrofit that infrastructure, or allow it to stand idle. This does not mean that such emissions are unavoidable, but rather that a very strong policy intervention would be required."[96]

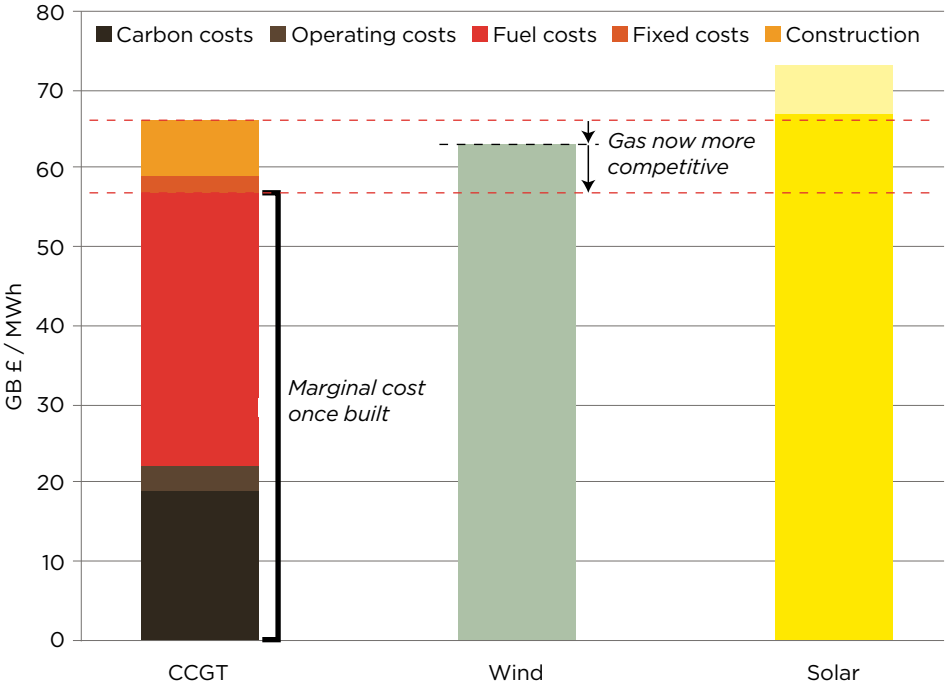
To illustrate the problem, consider Shell's Jackdaw gas field, located in the UK's Central North Sea. Rystad Energy estimates that to be commercially viable, the project requires a gas price of around US $5.70 per thousand cubic feet (kcf). Shell is expected to make a final investment decision in 2019, which depends on whether Shell expects gas prices to remain above this level for much of the project lifetime. But once the project has been developed, the economic incentives push for continued production as long as the gas price remains above the marginal operating cost of about $3.00/kcf.[97] If a build-out of wind and solar power in the UK pushed down the gas price, a field like Jackdaw would continue producing gas, even if foreknowledge of the price drop would have deterred Shell from approving the project in the first place. The same applies to a pipeline transporting the gas and to a power station that burns it. These become "stranded assets,"[k] operating on a marginal cost basis but unable to generate the required return on capital over the project life.

For power generation, the levelized cost of electricity (LCOE) incorporates all of the aspects of costs, and so gives a simplified comparator between generating technologies that have different capital intensities. The UK government has estimated that combined-cycle gas turbines have an LCOE of around GBP 66 per MWh (USD 93), competitive with onshore wind at GBP 63/MWh and solar at GBP 67 to 73/MWh.[98] But once a power station has been built, it will keep operating as long as it can sell electricity for more than the marginal cost of producing it, estimated at GBP 58/MWh, most of which consists of the cost of buying gas. In other words, even if renewable power were cheaper than gas power, it might not be able to compete with gas because of the lock-in caused by the up-front capital that was invested.

The longer-lived the infrastructure, the more persistent these lock-in effects. Oil and gas fields commonly operate for 20 or 30 years after an investment decision, exploration can effectively lock in emissions for 40 years, and tar sands projects often operate for 60 or more years. Pipelines, rail infrastructure, and power stations are commonly considered 40-year investments, and in reality often continue to operate beyond that. Thus decisions made now can lock in emissions during precisely the decades when they need to be rapidly reduced.

There are also significant political and institutional effects. The IEA believes that policy action should all be focused on reducing demand for fossil fuels (or

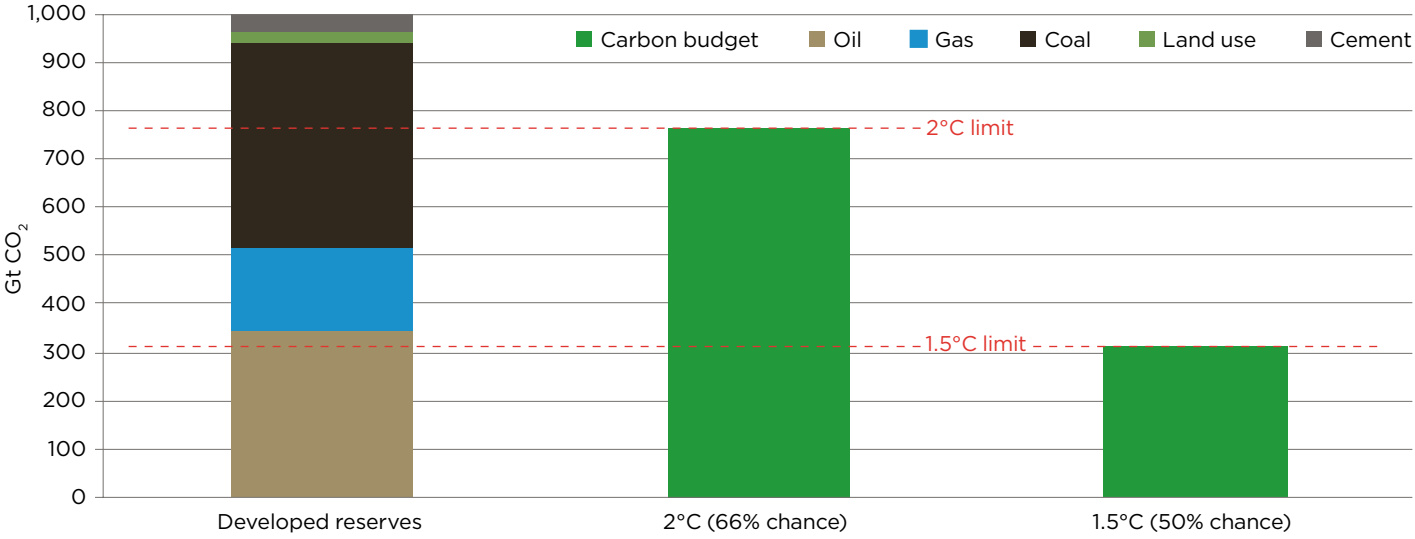
Figure 5: Illustration of Lock-In for Power Generation



Source: UK BEIS[99]

k A stranded asset is an investment that – due to events occurring after the capital is sunk – fails to deliver a commercial return

Figure 6: Emissions from Developed Reserves, Compared to Carbon Budgets for Likely Chance of 2°C and Medium Chance of 1.5°C



Sources: Rystad Energy, IEA, World Energy Council, IPCC, Oil Change International analysis

switching between them), rather than on addressing supply. We know that the amount burned is the same as the amount extracted. The demand-side policy is supposed to lead to reduced supply through the market mechanism: A reduction of demand relative to supply leads to a fall in the fuel price, making the more expensive supply sources unviable. But what actually happens when the price falls significantly is that producing companies ask governments for subsidies, often with the political threat of lost jobs. This was precisely what happened after the oil price fall in 2014: In 2015 and 2016, following a heavy oil industry lobbying campaign, the UK introduced its largest oil tax breaks in a generation, including zero-rating the petroleum revenue tax. The overall effect was to reduce the marginal tax rate on the oil industry from a 60 to 80 percent range to a flat 40 percent, one of the lowest in the world.[100]

A growing body of literature thus suggests that restricting fossil fuel supply can be an effective, and necessary, part of efforts to mitigate climate change.[101]

ENOUGH ALREADY

Research by Oil Change International has found that too much oil, gas, and coal production is already potentially locked in for governments to achieve the Paris goals. The oil, gas, and coal in fields and mines that have already been built – where the up-front capital is already invested – are sufficient to take the world beyond 2 degrees Celsius of warming, as shown in Figure 6.

To avoid worsening this problem, the fossil fuel industry must stop opening new fields and mines and governments must oversee a managed decline of existing production over the coming decades.

Essentially, we are now at the last moment where we still have an opportunity for an orderly and just transition to clean energy, together with a managed decline of the fossil fuel industry. Continuing to explore and develop new resources would mean that dangerous climate change can only be avoided by closing many more existing extractive operations, entailing an even more disruptive and costly change at some later date, including the loss of investments and economic and social instability as economies and jobs dependent on fossil fuels collapse.

Figure 7: Balance of Scenarios in IEA Press Releases for Last Three Editions of WEO

Source: IEA[106]

WRONG SCENARIO IN THE WRONG PLACE

The NPS occupies most of the narrative in the *WEO* and is given more comprehensive detail in data tables than the two secondary scenarios (CPS and SDS). Every year, the press release accompanying the *WEO* focuses almost entirely on describing the projections of the NPS, with occasionally a brief mention of the climate scenario (450 Scenario or SDS) at the end (see Figure 7).[102] It is then unsurprising that the media coverage tends to have forecast-like headlines such as "Upcoming surge in shale oil production will be 'biggest oil and gas boom in history,'"[103] "'Oil era is far from over,' says IEA's annual report"[104] and "Global oil demand to withstand rise of electric vehicles -IEA."[105] The IEA avoids describing the NPS as the "most likely" scenario and comments that it is not intended as a forecast, but rather that each scenario "depicts an alternative future, a pathway along which the world could travel if certain conditions are met."[107] In a detailed discussion of the meaning of its scenarios, the IEA expresses some frustration that the NPS is often treated as a forecast, "despite our protestations to the contrary."[108] However, knowing how it is routinely used, the IEA should take responsibility for what it publishes. It is never a convincing defense when a producer of a harmful product argues that responsibility should rest instead with whoever used their product.

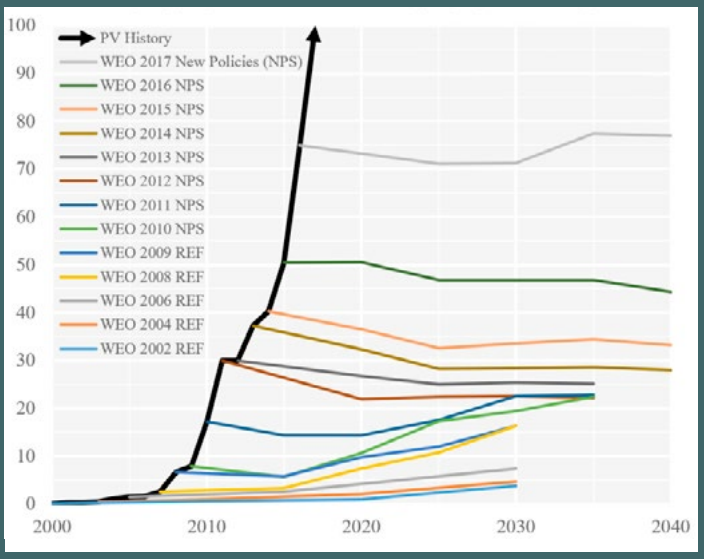
In any case, the IEA does little to discourage the use of the NPS as a prediction, but rather reinforces decision makers' view of it as the future they should prepare for. The IEA presents the NPS as "our main scenario" which describes "where are we heading," informing people as to "how much more energy are we going to need."[109]

The IEA argues that the three-scenario structure is a way of demonstrating to governments how far off course the world is from their stated goals by comparing where the energy system is headed under existing policies (the NPS or CPS) with where governments want to go (the SDS).[110] In principle, this logic is sensible, but it is not reflected in the *WEO*'s actual presentation. The problem is that the NPS is the central scenario, which is thereby used to inform the majority of energy decisions. Furthermore, the *WEO* describes the three scenarios separately, rather than explicitly comparing them.

BOX 2: The IEA's Poor Forecasting Record

As a forecast of the future balance of energy sources, the *WEO* has been dramatically unsuccessful, especially in relation to renewable energy. Figure 8, created by Auke Hoekstra of the Eindhoven University of Technology, shows projections in the last few editions of the *WEO* of added renewable capacity compared with what actually occurred. Each year, the IEA forecasted a flattening in the growth of the renewable energy industry, or even a reduction. As the Energy Watch Group has pointed out, the IEA appears to assume that renewable energy is growing linearly (so annual additions are flat), whereas the trend – and the usual pattern in an early stage of technological development – is exponential.[111]

Figure 8: Annual Photovoltaic (PV) Capacity Additions



Source: Auke Hoekstra[112]

Physicist Paul Mainwood has observed that the IEA's renewable energy forecast (in the NPS) for any given year has been revised upwards by an average of 9 percent with each edition of the *WEO*. As an exercise (and recognizing the limitations of such projections), Mainwood extrapolated these "corrections" for future forecasts, finding that the deployment curve maintains its exponential shape, reaching a 25 percent share of global electricity generation by around 2022 (the IEA has it reaching 20 percent in 2038).[113]

One reason for the under-forecasts of renewables is the IEA's inherent conservatism.[114] It is easier (in all modeling) to imagine a continuation of current trends than genuine disruption; in fact, a rigorous quantitative, model-based analysis – as provided by the IEA's World Energy Model – tends to exacerbate such biases but perversely increases the forecaster's confidence in their predictions.[115] Technology-based disruption is very hard to predict, but use of a historical data model ironically makes it even harder and encourages only incremental changes as errors are repeatedly realized. Culturally, these trends are no doubt also reinforced by the IEA's closeness to the fossil fuel industry (see page 33). As an organization created and governed by national governments there is also a bias to avoid controversy, conflicts of interests, and disruption.

In its defense, the IEA argues that the NPS is not a forecast, but rather a description of a possible future based on a set of assumptions.[116] That is a sensible approach to futurology: Predictions are always at the mercy of the unforeseen, and only as good as their assumptions. But as we have noted, that is not how the *WEO* is used; instead it is used as a prediction for what will occur, a usage the IEA's presentation tends to encourage.

On top of the IEA's inherent biases, the NPS will almost inevitably understate renewable energy growth, by definition. The NPS is defined as a future in which existing policies continue, and proposed policies are implemented, but no more. Policies supporting renewable energy tend to get more ambitious over time, and as such renewable energy deployment will exceed the NPS projections. Furthermore, such models tend to be very poor at forecasting non-linear, disruptive technological change. This raises questions about the value of the NPS as a planning tool for policy and investment.[117] Meanwhile, if the relevance of the NPS is limited now, an incidence of herd behavior in the financial markets could make it all but obsolete.

The IEA could begin to address these problems by adding a section in the *WEO* on how forecasts have been revised since the previous edition, any recurring issues and lessons learned, and perhaps also benchmarking against other forecasts, including those from the renewable energy industry itself.

4. IGNORING THE PARIS GOALS: THE SUSTAINABLE DEVELOPMENT SCENARIO

SMALL CHANGE

We have seen how the use of the NPS as the central scenario in the *WEO* encourages decisions that push the world towards severe climate change. The *WEO* also includes – though does much less to highlight – a scenario intended to show a pathway to meet the energy elements of the Sustainable Development Goals. However, the Sustainable Development Scenario describes a future not so different from the present, which is on track to blow past these internationally-agreed goals. The SDS sees just a 53 percent reduction in coal by 2040, a 25 percent reduction in oil, and an actual increase in gas, as shown in Figure 9.

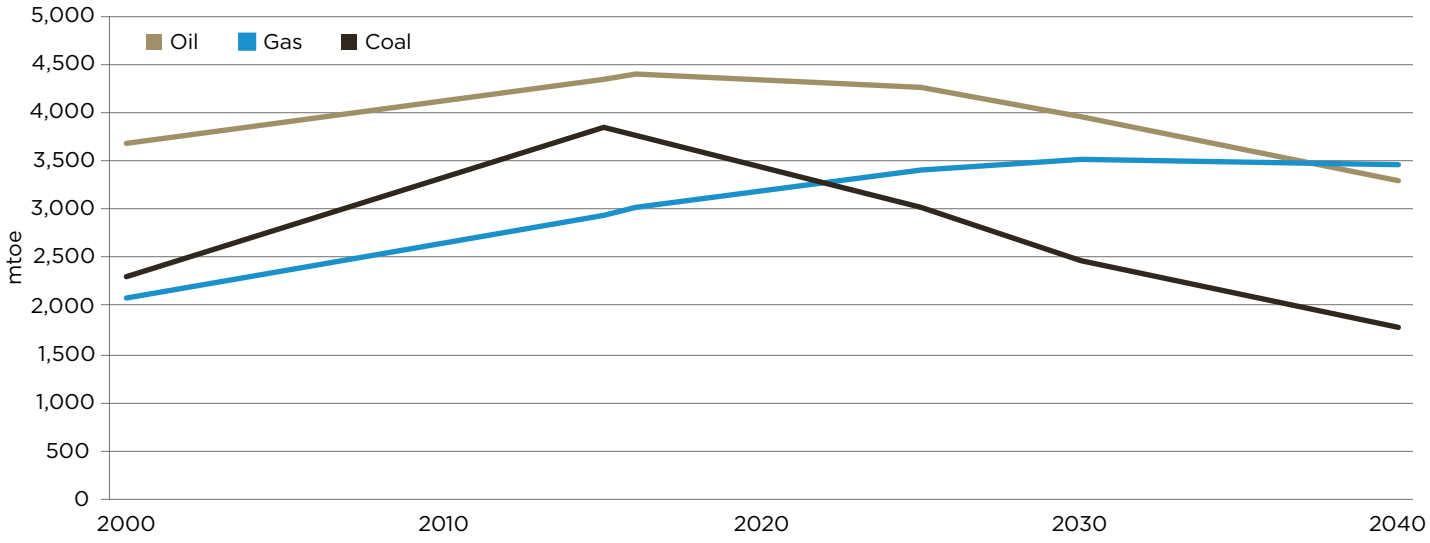
WE NEED BETTER ODDS

The IEA first published its 450 Scenario in 2009, reflecting the then aim of limiting warming to 2 degrees Celsius, which was proposed by Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen and formally adopted the following year at Cancún. The 450 Scenario aimed to be consistent with a 50 percent probability of keeping warming below 2 degrees Celsius, by limiting atmospheric concentration of greenhouse gases to 450 parts per million. By definition, the 50 percent odds mean that the outcome is equally likely to be higher or lower than 2 degrees Celsius: The most likely (median) outcome is 2 degrees Celsius.

Since then however, new scientific findings have indicated that even 2 degrees Celsius of warming could be considered excessively dangerous. A 2016 assessment led by Carl-Friedrich Schleussner of Potsdam Institute on Climate Impacts found that reductions in water availability for the Mediterranean region would nearly double from 9 percent to 17 percent between 1.5 degrees and 2 degrees; the projected lengthening of regional dry spells worldwide would increase from 7 percent to 11 percent; wheat yields would be reduced by 15 percent at 2 degrees compared to 9 percent at 1.5 degrees in a best estimate, while the reduction could be as bad as 42 percent at 2 degrees versus 25 percent at 1.5 degrees. The difference between 1.5 degrees and 2 degrees is likely to be decisive for the survival of tropical coral reefs.[119] Higher temperature thresholds also increase the risk of positive feedback loops in the climate system which could lead to runaway climate change.[120]

The Structured Expert Dialogue within the UNFCCC summarized the evolving understanding in 2015: "The 'guardrail' concept, in which up to 2 degrees Celsius of warming is considered safe, is inadequate and would therefore be better seen as an upper limit, a defense line that needs to be stringently defended, while less warming would be preferable."[121] This is why the Paris Agreement includes more rigorous goals of keeping warming "well below" 2°C and pursuing efforts to keep it to 1.5 degrees Celsius. With a 50 percent chance of experiencing the severe dangers above 2 degrees Celsius of warming, the 450 Scenario is rendered obsolete by the Paris Agreement.

Figure 9: Oil, Gas, and Coal Primary Demand in SDS, *WEO 2017*



Source: IEA[118]

In recognition of this, in 2017 the IEA published two scenarios designed to give a 66 percent probability of keeping warming below 2 degrees Celsius. The Faster Transition Scenario[l] was published in March 2017, in a joint publication[m] by the IEA and IRENA, commissioned by the German government.[122] The Beyond 2 Degrees Scenario was published in June 2017 in the IEA's *Energy Technology Perspectives* report. Neither can be seen to fully reflect the Paris goals (see below, page 28), but they did constitute a step in the right direction.

In the 2017 *WEO*, the introduction of the Sustainable Development Scenario created an opportunity to align emissions goals with the Paris Agreement. It was an opportunity the IEA passed up. The SDS used the previous 450 Scenario as the "point of departure" on climate change,[123] while incorporating additional goals on energy access and air pollution as well as climate. It did not even use the two 66 percent-probability 2 degrees Celsius scenarios the IEA had published earlier that year.

The *WEO 2017* included a brief sketch of the Faster Transition Scenario, rather than incorporating its emissions pathway into the SDS. But whereas the *WEO 2016* had also included a sketch of a 1.5-degree Celsius scenario, *WEO 2017* dropped this, and barely mentioned that crucial part of the Paris goals *(see page 12 for a list of scenarios discussed in this report)*.[124]

l This name was given in the WEO 2017; originally it was called the 66% 2°C Scenario.
m The IEA and IRENA could not however agree on the narrative conclusions, so not only wrote separate chapters, but presented two separate executive summaries, and carried out media and communication work independently.

PARIS OR NOT PARIS?

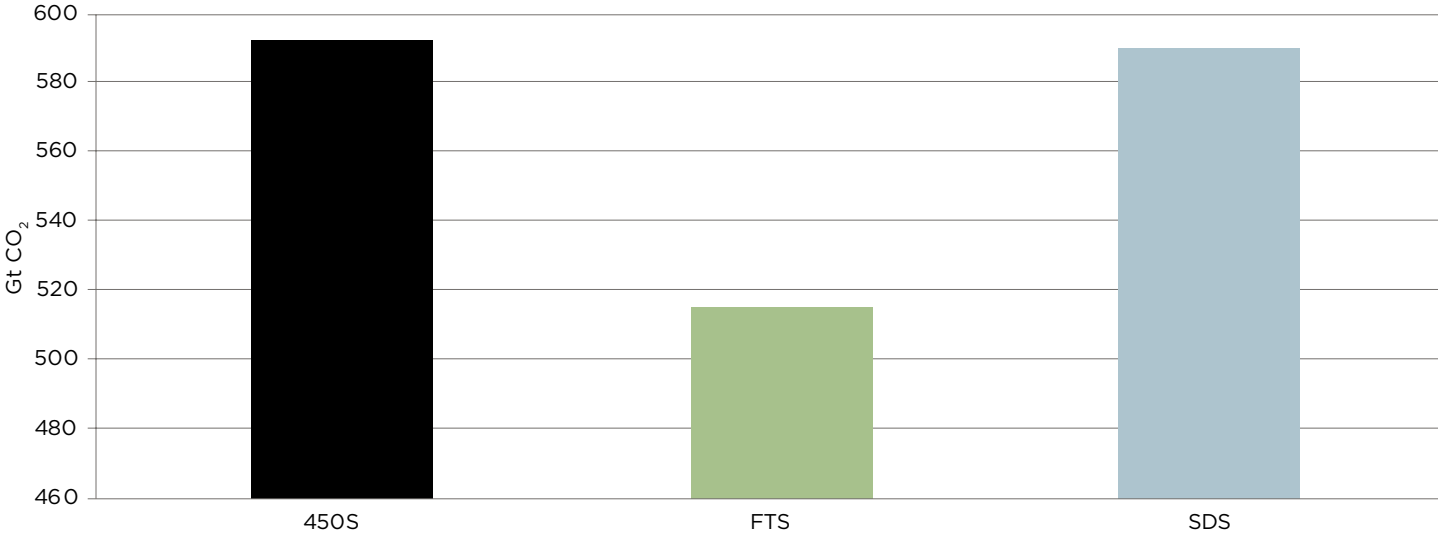
Having faced criticisms from civil society[125] and some investors and policymakers over previous descriptions of its scenarios, the IEA does not describe the SDS as aiming for a 50 percent chance of staying below 2 degrees Celsius. Instead, it rather vaguely states that the SDS is consistent with the Paris Agreement goals *(see Box 3, below)*. However, as Figure 10 shows, the emissions projected in the SDS did not change compared to the 450 Scenario, and remained significantly higher than in the IEA's Faster Transition Scenario.

Indeed, when asked by Oil Change International, IEA Executive Director Fatih Birol confirmed that the SDS climate targets are "fully in line" with the 450 Scenario, whereas meeting the Paris goals "would require a huge, exceptional transformation of our energy system in a very short period of time."[127]

The SDS projects cumulative CO_2 emissions of 580 Gt between 2018 and 2040. Let us compare this with the IPCC carbon budget for a 66 percent chance of keeping warming below 2 degrees Celsius – the minimum level of ambition that could be considered aligned with the Paris goals. The total IPCC budget for *all* emissions for the rest of the century is 760 Gt.[128] If we assume non-energy emissions of 180 Gt,[129] the carbon budget for minimum alignment with Paris goals would be entirely exhausted in 2040, unless technologies are invented to suck CO_2 out of the atmosphere *(see Box 3, below)*. Even if we accepted the IEA's less realistic estimate of 90 Gt of non-energy emissions, that would leave just another 90 Gt of emissions after 2040, which would require emissions to fall at a staggering rate of 20 percent per year.

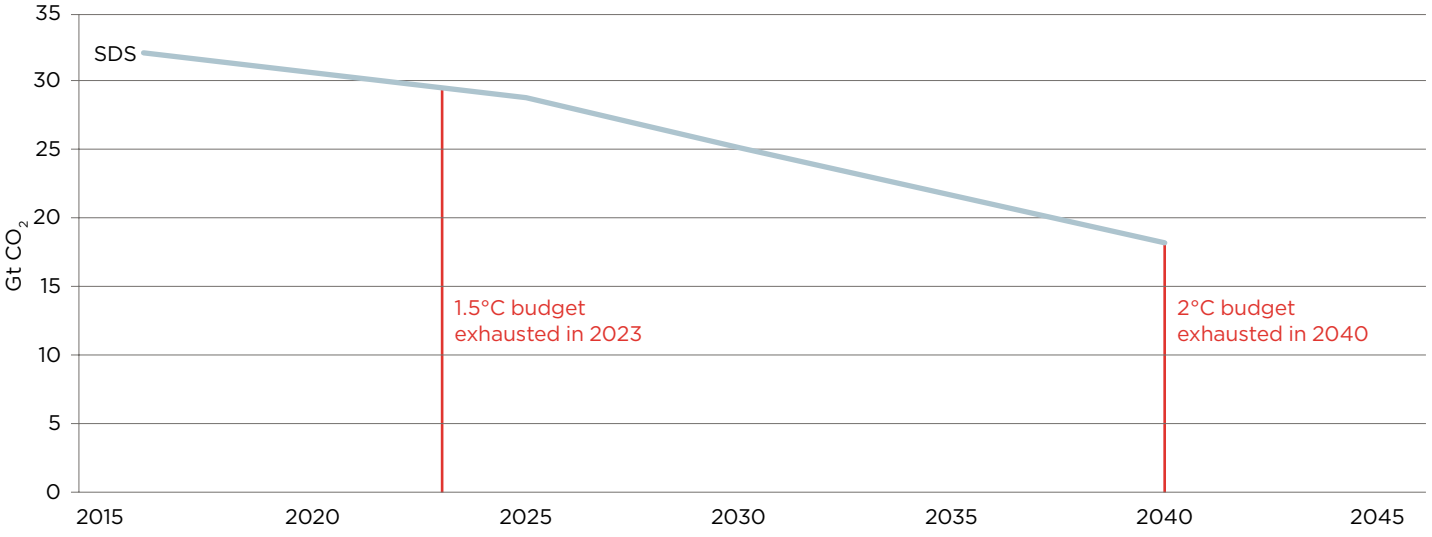
The IPCC carbon budget for a 50 percent chance of keeping warming below 1.5 degrees Celsius is 310 Gt. Again assuming 180 Gt of non-energy emissions, the entire budget would be exhausted by 2023 under the SDS.

Figure 10: Cumulative Energy Emissions 2018-40, Comparing Three IEA Climate Scenarios



Source: IEA[126]

Figure 11: Energy-Related CO_2 Emissions Under SDS, Compared to 1.5 Degrees Celsius and 2 Degrees Celsius Carbon Budgets



Sources: IEA, IPCC, GCP[130]

BOX 3: Betting on Unproven Technologies

The IEA rightly observes that the ultimate temperature outcome will depend on emissions after 2040 as well as before, and also on non-energy and non-CO_2 emissions. The *WEO* states that the SDS' emissions in 2040 are at the lower end of the range of IPCC scenarios that lead to between 1.7 and 1.8 degrees Celsius of warming (equivalent to a 66 percent chance of keeping warming below 2 degrees Celsius).[131] This is true only if one includes scenarios that require a large amount (more than 5 Gt per year) of negative emissions later in the century[132] – relying on technologies that so far exist only in the theoretical models. There are significant dangers in placing such a consequential bet on as yet non-existent or unproven technology.[133]

To illustrate the practical challenges of such an approach, Aberdeen University professor Pete Smith and colleagues estimate that removing 3.3 Gt per year from the atmosphere by the end of the century would require a land area of 380 to 700 million hectares, which is up to twice the size of India.[134]

On top of the reliance on negative emissions to reach the Paris goals, the SDS (like the 450 Scenario) also relies on carbon capture and storage (CCS), another technology that is not yet proven.[135] For example, the SDS expects about 2 Gt of carbon dioxide to be captured per year by the mid-2030s.[136] This implies a smaller reduction in fossil fuel use than a more precautionary approach would have indicated. And while carbon capture and storage (CCS) technology is well understood in theory, many actual projects have been beset with problems. For example, the world's first industrial-scale CCS project, the Sleipner project in Norway, started in 1996 and was assumed to be safe until it was discovered to have fractures in its caprock in 2013.[137]

The other major problem facing CCS is its cost. The first project that applied CCS to a power project, Boundary Dam in Canada, came online in 2014. The plant was exceptionally expensive to build and has struggled to operate as planned, suffered considerable cost overruns, and been forced to pay out for missing contracted obligations.[138] Even CCS advocates recognize the "outstanding commercial challenges" that projects around the world face.[139] Many advocates have pulled back from the technology in recent years, including the United Kingdom, U.S., and some European utilities.[140] In the words of Francesco Starace, the Enel CEO (and then chair of trade association Eurelectric), "I think CCS has not been successful. It doesn't work, let's call it what it is – it is simply too expensive, too cumbersome, the technology didn't fly."[141]

Today many analysts argue that wind and solar power, which are proven technologies, are likely to remain cheaper than CCS, even as CCS technology improves.[142] It appears that the prominence of CCS among proposed climate solutions rests not on its affordability, effectiveness, or efficiency, but rather on a political failure to challenge fossil fuel dependence.

INVESTORS CALL FOR TESTING PORTFOLIOS IN CLIMATE SCENARIO

In recent years, there has been increasing recognition that continuing with fossil fuel business as usual is not compatible with avoiding dangerous climate change. As groups like the Carbon Tracker Initiative have highlighted this fact, investors in fossil fuel companies have become concerned that if governments succeed in sufficiently constraining emissions, some fossil fuel assets will become "stranded." This has led to increasing scrutiny of how such investments would fare in an emissions-constrained world.

In 2017, the Task Force on Climate-Related Financial Disclosures reported to the G20's Financial Stability Board, led by Bank of England Chairman Mark Carney. It recommended a more robust approach to planning using scenarios to consider business performance in more than one possible future. In particular, these futures should include at least one where climate goals are met.[143] As noted above, it is the NPS – IEA's "main scenario" – that is most commonly used in justifying energy decisions and that is still seen as the base case for judging investments. However, investors are increasingly examining energy transition risk by testing investments against a climate scenario.

Some have interpreted this requirement as being met by the IEA's 450 Scenario, or by its replacement the SDS. Global investment banks such as Barclays[144] and HSBC[145] and pension funds such as CalPERS[146] have used the 450S to define their expectations of companies for aligning with climate goals. The Asian Infrastructure Investment Bank mistakenly uses the 450S to guide how "energy infrastructure investments need to be reshaped to meet the Paris Agreement goals."[147]

By testing investment portfolios against a scenario that falls short of the Paris goals, investors may be given a false sense of confidence of their portfolios' robustness, or the sense that the goals can be met with limited change in investment practice. Using the SDS or 450S significantly overstates oil and gas investment compared to the Paris goals, as we lay out in the next section. This suggests the SDS provides too weak a stress test, which in turn masks the true risks to fossil fuel investments.

It is important to note that losing money on fossil fuel investments (including their associated rail, port, and pipeline infrastructure) is not the only or even the biggest threat to financial investors: They also face losses due to the impact of climate change itself, both to their investments in climate-vulnerable sectors such as food, property, and insurance, and to the wider economy. Estimates since the Stern Review of 2006 have commonly put the impact at several percent of global gross domestic product by the late twenty-first century, and a more recent study of historic correlations between temperature and economic activity suggested that unmitigated climate change could cause as much as a 20 percent reduction in 2100 output.[148] A study by the Economist Intelligence Unit, commissioned by Aviva Investors,

estimated that USD 4.3 trillion of today's financial assets are at risk from climate change. These estimates are based on discount rates used by investors; with the lower discount rates used in the public sector, the value at risk could rise to USD 43 trillion.[149]

CHANGE THAT OIL COMPANIES CAN BELIEVE IN

The largest oil and gas companies – and some coal companies – have stated that their portfolios of assets are robust in the 450 Scenario or SDS:

- **ExxonMobil:** "Considering the IEA's Sustainable Development Scenario (a 2°C scenario), the IEA estimates that almost $14 trillion of investment will be needed for oil and natural gas supply between 2017 and 2040... Considering the 2°C Scenarios Average, we believe our reserves face little risk."[150]

- **Shell:** "The aggregate impact under the IEA's 450 Scenario would be more positive overall for us than our own outlook."[151]

- **Chevron:** "The 2017 commodity price used in reserve calculations is similar to the lower price indicated in the IEA's SDS; thus, current reserves estimates indicate that assets would not be stranded and there would not be a 'carbon bubble' even in an aggressive climate change–response scenario such as the IEA's SDS."[152]

- **BP:** "Even in the IEA 450 scenario, by 2035, the level of oil and gas is pretty much around the same level as today. Which, if you think about the very sharp decline rates, means you have to keep on investing."[153]

- **Total:** "Under the IEA's 2°C scenario, [oil and gas] will still comprise more than 40 percent of the primary energy mix in 2035. So we must not embrace the unrealistic idea of an abrupt transition."[154]

- **BHP Billiton:** "In the 450 scenario, there is a significant increase in the contribution of renewables and nuclear to the overall fuel mix. However, fossil fuels are still expected to supply around 70 per cent of global primary energy needs in 2030 and 60 per cent in 2040... Our analysis shows that BHP Billiton will continue to create substantial value for shareholders in this scenario. The demand for most of our products will continue to rise."[155]

- **Glencore:** "[In the 450 Scenario] Seaborne traded coal [is] differentiated from the broader coal market as ongoing investment in low cost coal-based power generation across south east Asia supports seaborne demand. Glencore's competitive portfolio continues to generate acceptable returns."[156]

Note: All of the above companies except Total treat the NPS or their equivalent in-house scenarios as the most important basis for planning, with the 450S or SDS used only to test what they consider as an unlikely alternative future.[157]

When challenged by investors or civil society as to their businesses' consistency with a safe climate, the companies thus argue that they should continue with business as usual, continuing to invest in exploring for and developing new reserves. This is of little use to investors: It is a stress test with no stress.

The 450 Scenario is commonly – though wrongly – accepted by decisionmakers to reflect the most ambitious level of climate action imaginable. The oil companies are keen to encourage this view, as a more robust climate scenario that is actually aligned with the Paris goals might require them to change their plans. Thus BP's Dale has called it a "really quite extreme case" (in the same sentence as saying it would not affect the oil and gas industry).

TOWARDS PARIS-ALIGNED CLIMATE SCENARIOS

We have focused above on the SDS (and its predecessor 450S), which appears as a secondary scenario in the *WEO* and so is the most commonly used of IEA's climate scenarios. In 2017, the IEA published two more ambitious scenarios, which would give a 66 percent probability of keeping warming below 2 degrees Celsius (see also the table on page 12). These are a positive addition, although they cannot be seen to be fully aligned with the Paris goals. Not only do both scenarios ignore the goal of 1.5 degrees, the one-in-three odds of exceeding 2 degrees constitute an uncomfortably high level of risk, and certainly do not match the understanding of 2 degrees as "a defense line that needs to be stringently defended."[158] Furthermore, whereas that understanding would require a precautionary approach to technological unknowns, neither scenario adopts one, although each has its strengths.

The **Faster Transition Scenario** (FTS) was published in March 2017 in a standalone report co-published with IRENA, commissioned by the German government. That report examined the implications of the scenario in some detail, including global aggregate figures on energy production and consumption, although unfortunately did not provide data tables with a geographical breakdown (as provided for the NPS, SDS and CPS in the *WEO*); this limits its analytical usage, such as by investors. It reappeared in *WEO* 2017, though with only three pages of discussion and almost no data.

The FTS takes a welcome precautionary approach to negative emissions technology, aiming to describe what would be necessary if such technologies are not successfully invented. On the other hand, it relies on three optimistic assumptions that may understate the pace of change needed even for a 66 percent chance of keeping warming below 2 degrees Celsius:

- **Carbon capture and storage** (also an unproven technology, although at a later stage of development than most negative emissions methods – *see Box 3, on page 27*): that 3 Gt of CO_2 will be captured per year by 2035;

- **Non-energy emissions:** that emissions from cement calcination will be just 90 Gt from 2015 to 2100 (45 years' worth at current rates);

- **Delayed action:** that a greater pace of emissions reductions will occur after the time period the scenario describes (up to 2050).

We have estimated that these three assumptions inflate the space for fossil fuel emissions by 31 percent.[159]

The **Beyond 2 Degrees Scenario** (B2DS) was published for the first time as a secondary scenario in the IEA's 2017 edition of the *Energy Technology Perspectives* report *(see Box 1, on page 15)*. Data are available on the IEA's website for those who have bought the report.[160]

While not making the same assumptions as the FTS about non-energy emissions or delayed action,[m] the B2DS is however very bullish about new, unproven technologies (deliberately so, because its purpose is to show what technology could achieve). Most significantly for its forecasts of fossil fuel demand, it relies heavily on both CCS and negative emissions. For CCS, it requires capture of 5.8 Gt per year of fossil fuel emissions by 2040 and 10.9 Gt per year by 2060 – both highly optimistic targets. As for negative emissions, it requires sucking a further 4.9 Gt per year out of the atmosphere through bioenergy-CCS.[161] As mentioned above, the latter could require a land area up to three times the size of India. If successful, such technologies may help humanity reduce warming further than would otherwise be possible. But given that we do not know whether they will become available, we must not predicate avoiding the dangers above 2 degrees Celsius on them. Thus while the B2DS shows a vision of what technology might be possible, it does not provide a useful guide to climate-constrained investment or policy.

So what would Paris-aligned scenarios look like? We propose two alternative approaches:

- A single scenario with a high probability (say, 80 or 90 percent) of keeping warming below 2 degrees Celsius, reflecting the notion of "stringent defense"; or
- Two scenarios: one with modest probability (say, 66 percent) of keeping warming below 2 degrees Celsius and the other with 50 percent probability of keeping below 1.5 degrees Celsius – the aim of energy decisions should then be to keep emissions as far as possible below the 2 degrees Celsius scenario, and as close as possible to the 1.5 degrees Celsius scenario.

The scenarios should be transparent how they would look if those technologies do not become available.

The IEA did start to develop a **1.5 Scenario** (1.5S), which would potentially reflect the full ambition of the Paris goals. But it was mentioned only once, in the *WEO* 2016, where it was given three of the 680 pages, and no data on what energy usage would be. As such, it is impossible to analyze it further. It did not get mentioned the following year in the *WEO 2017*.

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m Covering a time period to 2060, the B2DS does not need to assume delayed action on emissions. Furthermore, it integrates industrial process emissions (primarily from cement calcination) into its analysis, so the only external component is from land use change, which is somewhat optimistic but not to an excessive extent.

5. HOW MUCH MISDIRECTED CAPITAL?

Focusing on oil and gas extraction, we can estimate how much excess investment the IEA is calling for, compared to what would be implied if the Paris goals are met.

As in the estimates of excess emissions in earlier sections of this report, we represent the Paris goals using the IPCC carbon budgets for a 66 percent probability of keeping warming below 2 degrees Celsius and for a 50 percent probability of keeping it below 1.5 degrees Celsius. Again, we assume that 70 percent of the 2 degrees Celsius budget is used by 2040, and 100 percent of the 1.5 degrees Celsius budget. We further assume that those budgets are shared between oil, gas and coal in the same proportions (by emissions) as the IEA's Beyond 2 Degrees Scenario (B2DS).[162] We treat oil and liquefied natural gas (LNG) each as trading in a single global market; we divide dry gas into five regional markets, assuming total gas demand is shared between the markets in the same proportions as in the B2DS.

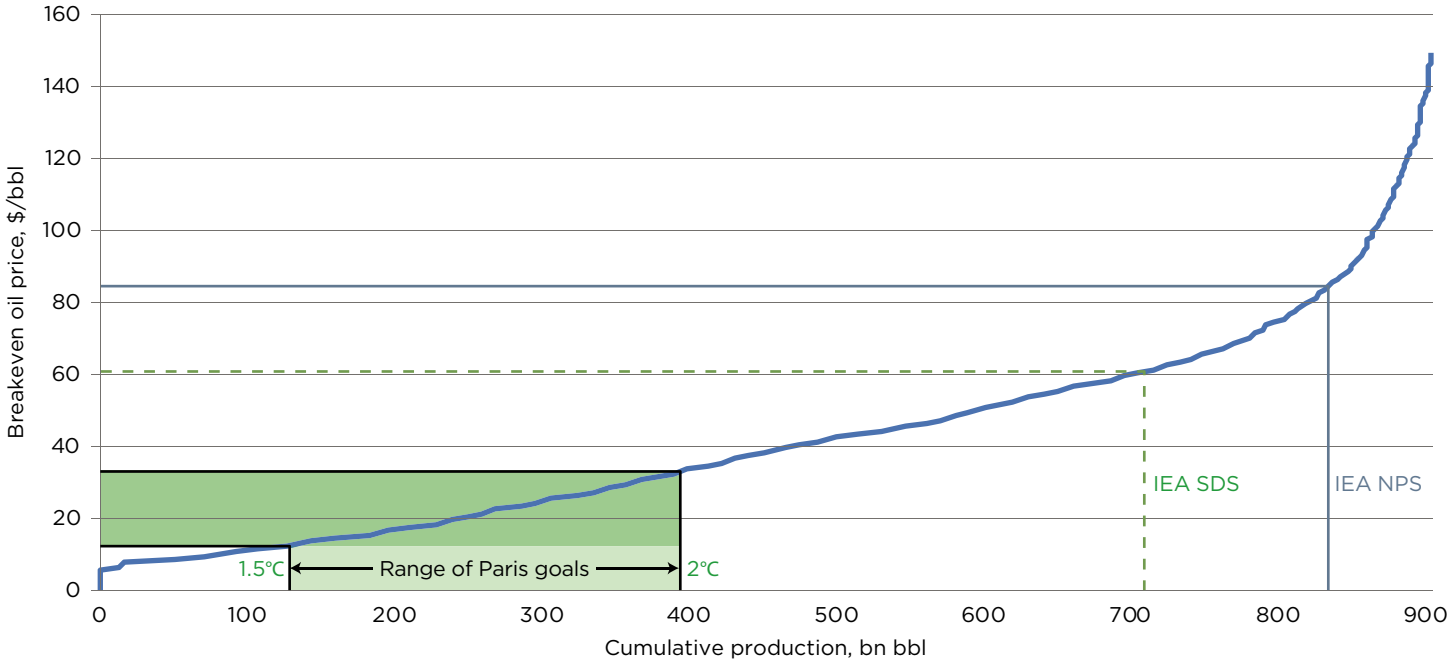
The cumulative production between 2018 and 2040 is shown in Table 1, comparing the IEA's NPS and SDS scenarios with the range representing the Paris goals.

Table 1: Cumulative Oil and Gas Production, 2018 to 2040, in Four Scenarios

	Oil (bn bbl)	Dry gas (tcf)					LNG (tcf)
		N. America	Europe & Russia	Asia-Pacific	Mideast & Africa	S. & C. America	
Main IEA scenarios:							
NPS	830	865	868	507	713	169	558
SDS	704	790	821	473	606	139	524
Range of Paris goals:							
2°C	398	357	479	239	287	65	215
1.5°C	127	114	249	47	92	21	62

Sources: IEA, IPCC, Global Carbon Project[163]

Figure 12: Oil Cost Curve: Cumulative Production 2018-40 Versus Breakeven Oil Price



Sources: Rystad Energy,[165] Oil Change International analysis

Table 2: Cumulative Capital Expenditure (US $ bn) in Oil and Gas Extraction, 2018-40, in Four Scenarios

	Oil	Dry gas					LNG	TOTAL
		N. America	Europe & Russia	Asia-Pacific	Mideast & Africa	S. & C. America		
Main IEA scenarios:								
NPS	9,730	654	1,345	1,120	519	485	868	**14,361**
SDS	6,420	654	1,196	964	292	214	725	**10,465**
Range of Paris goals:								
2°C	2,025	150	394	394	22	67	116	**3,168**
1.5°C[n]	343	5	116	85	1	13	13	**576**

Sources: Rystad Energy,[166] Oil Change International analysis

For the purposes of the calculation, we adopt the IEA's assumption that climate policy focuses only on fossil fuel combustion and not supply, so that markets allocate a specified demand volume to supply by the cheapest fields. This approach arguably presents political challenges that could be overcome by approaches addressing both supply and demand *(See page 19)*.[164]

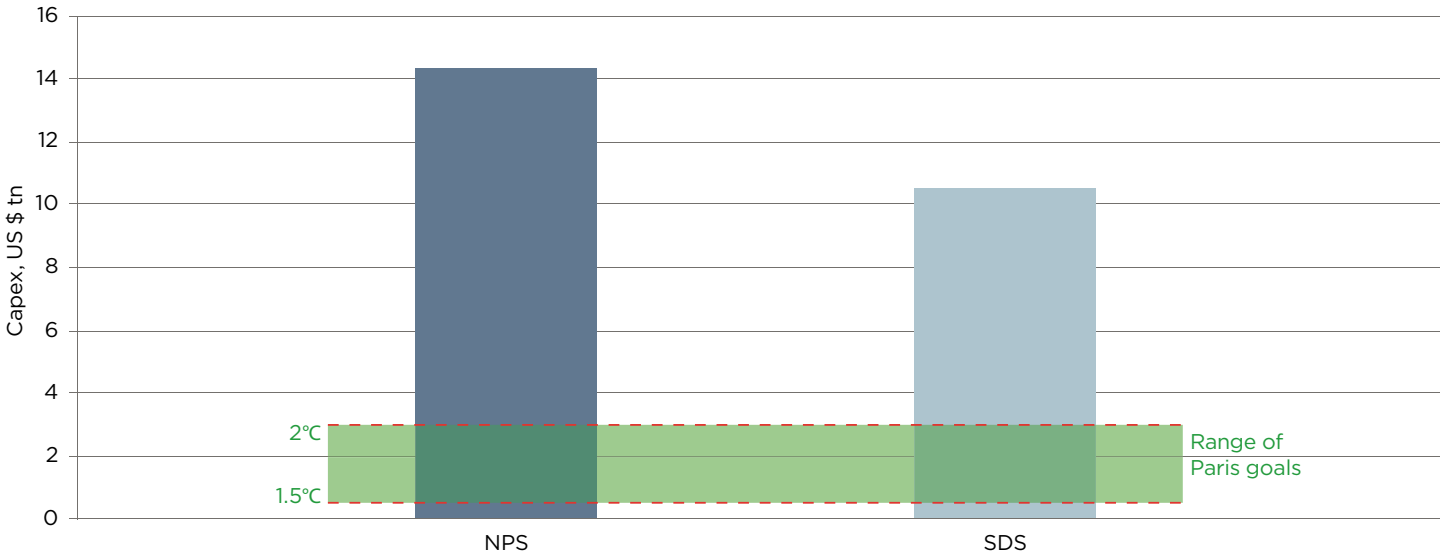
Figure 12 shows a cost curve for the world's oil fields, with projects arranged in order of increasing cost on the x-axis – from onshore Middle Eastern giant fields to deepwater and unconventional sources – and their breakeven price plotted on the y-axis. The estimates are drawn from the UCube database published by oil consultancy Rystad Energy. We conduct the same analysis for gas fields (not graphed).

On the cost curve, we superimpose the cumulative production levels from the scenarios above.[o] We see how the amount of oil in the IEA's NPS and SDS exceed levels that would be consistent with the Paris goals.

Assuming that the lowest-cost oil and gas resources will be the ones that meet the specified demand through market competition, we use the Rystad UCube again to estimate the capital expenditure requirement (capex) to extract the levels of oil and gas specified in the scenarios. This is shown in Table 2 and Figure 13 (this analysis does not include investments in fossil fuel transportation such as pipelines, nor in refining).

n If these investment numbers aligned with the 1.5°C target seem very small, bear in mind that the remaining carbon budget of 313 Gt CO_2 will be exhausted within eight years at current rates of emissions.
o i.e. matching their demand forecasts, minus refinery volume gains

Figure 13: Cumulative Capital Expenditure in Oil and Gas Extraction, 2018-40, in Four Scenarios



Sources: IEA, Rystad Energy, Oil Change International analysis

Using a different model (its own World Energy Model), the IEA estimates the upstream oil and gas capex requirement in the NPS as USD 15.4 tn over the period 2017-40[167] very slightly higher than our estimate using the Rystad UCube. We have made our own estimate in order to compare with different scenarios; however we note that our estimate is very close to the IEA's own.

We see that:

- Between 78 percent and 96 percent of the upstream oil and gas investment under the NPS - USD 11.2 to USD 13.8 trillion – is likely incompatible with meeting the Paris goals.

- Between 70 percent and 94 percent of upstream oil and gas investment under the SDS – USD 7.3 to USD 9.9 trillion – is incompatible with the Paris goals.

The important thing here is not the precise numbers[168] but the general finding: the investment called for in both the NPS and the SDS considerably exceeds the amount that would be aligned with the Paris goals.

This excess investment, beyond that aligned with the Paris goals, can lead to two possible outcomes. Either the sunk capital locks in emissions, causing the goals to be missed. Or the goals are achieved and the capital is wasted, becoming *fully* stranded (non-producing) assets and potentially leading to economic upheaval. In calling for more investment, the IEA greatly increases the likelihood of one of these two outcomes occurring.

6. ENERGY INFORMATION FOR WHOM?

The IEA is an advisory body to its 30 member countries, all of whom signed the Paris Agreement, committing to keep warming well below 2 degrees Celsius and to pursue efforts to keep it to 1.5 degrees Celsius. As such, the IEA ought to be advising its member countries on how to achieve these goals. Why does it not do so? In this section we outline three factors contributing to this misalignment: the influence of fossil fuel companies, conflicting objectives in the IEA, and the positions of member countries in climate politics.

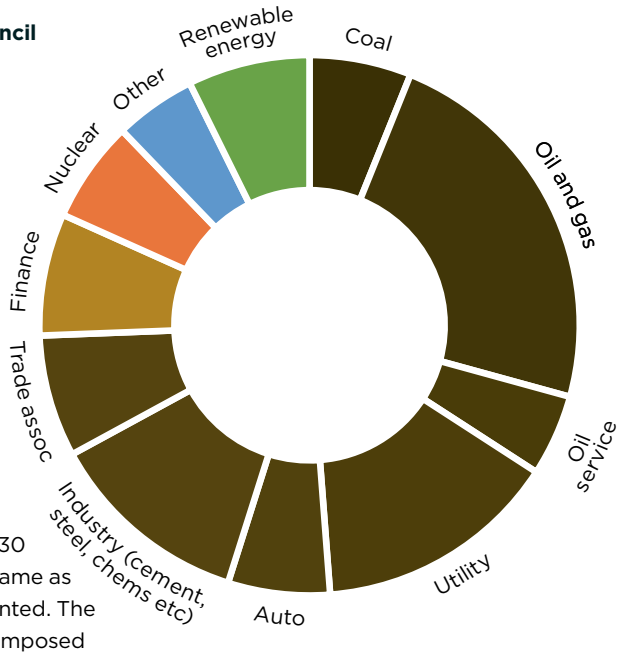
FOSSIL FUEL COMPANIES AT THE HEART

While formally an intergovernmental organization, in practice the IEA appears to be servant to two masters at the same time: its member countries, and multinational fossil fuel companies. And these two masters have very different interests when it comes to climate change and the energy transition.

The IEA's formal governance structure answers to its member countries. The IEA's Governing Board is made up of senior civil servants from the members and meets three or four times per year. Every two years, energy ministers from the member countries meet. At all of these meetings – Governing Board and Ministerial – energy companies are also invited, through the Energy Business Council (EBC). Generally, about 30 companies attend, roughly the same as the number of countries represented. The result is a formal IEA meeting composed of half member countries and half fossil fuel corporations. For example, the 2013 Ministerial included a dinner for both ministers and CEOs, where the CEOs of Peabody and Total presented on how energy investment could play a positive role in development and solving world poverty.[169]

Figure 14: Energy Business Council Companies by Sector

Source: IEA[171]



The EBC's stated purpose is to provide the IEA with a "reality check of its analysis" and to ensure its relevance to the industry.[170] As Figure 14 shows, almost all of the companies involved in the council either produce, consume, lobby for, or finance fossil fuels.

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Energy companies are also regularly consulted by the IEA and participate in its working groups and in advisory bodies. The Coal Industry Advisory Board is a formal IEA structure and effectively acts as an in-house lobby for the coal companies.[p,172] For example, in the run-up to the Paris climate summit in 2015, a CIAB submission asked the IEA "to explain to UNFCCC negotiators the indispensable role of advanced coal technologies in fulfilling the aspirations for [Paris]," and to "articulate the extensive role which coal is expected to play in the global energy mix to 2040 and beyond."[173]

The IEA encourages energy companies to provide staff on secondment, and at any time several IEA staff thus receive their salaries from energy companies, especially oil companies.[174]

Industry participation is especially strong in relation to the *WEO*, advising on which is one of the key roles of the EBC.[175] Most years, the EBC holds workshops to help shape the *WEO*.[176] Prior to the formation of the EBC, the CIAB was one of several organizations providing "substantial support and cooperation" for the *WEO*.[177] The CIAB and lobby group the World Coal Association regularly meet members of the *WEO* team.[178] At least two of the forty members of the team that wrote the 2017 World Energy Outlook were not IEA staff but secondees from oil companies, which continued to pay their salaries while they were writing the *WEO*.[179]

Many energy companies have their own global energy forecasting models and publications, including ExxonMobil, Shell, BP, Statoil, and Total. While generally presented as objective and expert analyses, these company forecasts tend to present the future of energy as their authors would like it to be seen, rather than conducting a genuine exploration of possible futures. For example, the first publication of forecasts in their current form was driven by ExxonMobil's public affairs department, which identified as its target audience a group it labelled "informed influentials": investors, policymakers, economists, and commentators.[180] Throughout the year, ExxonMobil presents its forecasts to these audiences in universities, think tanks, private meetings, and the media. These self-serving forecasts promote and encourage "fossil fuel fatalism" by arguing that achieving the world's agreed climate goals will be unlikely, and therefore that investment in fossil fuels should be continued and expanded. Yet the same industry authors play a central role in advising and even writing the IEA's forecasts.

Given the self-serving interests of these fossil fuel companies, their close role in influencing the *WEO* undermines the IEA flagship publication's reputation as a dispassionate source of analysis of the future of energy. In the words of Hermann Scheer, one of the founders of the International Renewable Energy Agency, the IEA 'leaves no stone unturned when it comes to emphasizing the long-term indispensability of nuclear and fossil energy.'[181]

ENERGY SECURITY VS CLIMATE?

The IEA was originally founded with an "energy security" mission, after the price shock and embargo of 1973 and 1974 with a charge to protect imports of oil to consuming countries. The IEA's mandate has evolved over time, but core threads of this underlying fossil fuel-focused mandate have remained. Today, the IEA has four purposes:[182]

- energy security of all fuels and energy sources;
- economic development and promotion of free markets in energy;
- environmental awareness, especially finding solutions to climate change and air pollution;
- engagement worldwide on energy and environmental challenges.

These different objectives are often at odds, pulling in different directions – with energy security (in the IEA's conception of it) and deregulated free markets often favoring the largest incumbent energy sources, fossil fuels. Energy security thus often means security of fossil fuel supply. Due to the organization's history, oil and gas continue to play a central role. Yet as we have seen, this functional purpose of promoting increased fossil fuel supplies is not consistent with the IEA's stated purpose addressing the climate challenge.

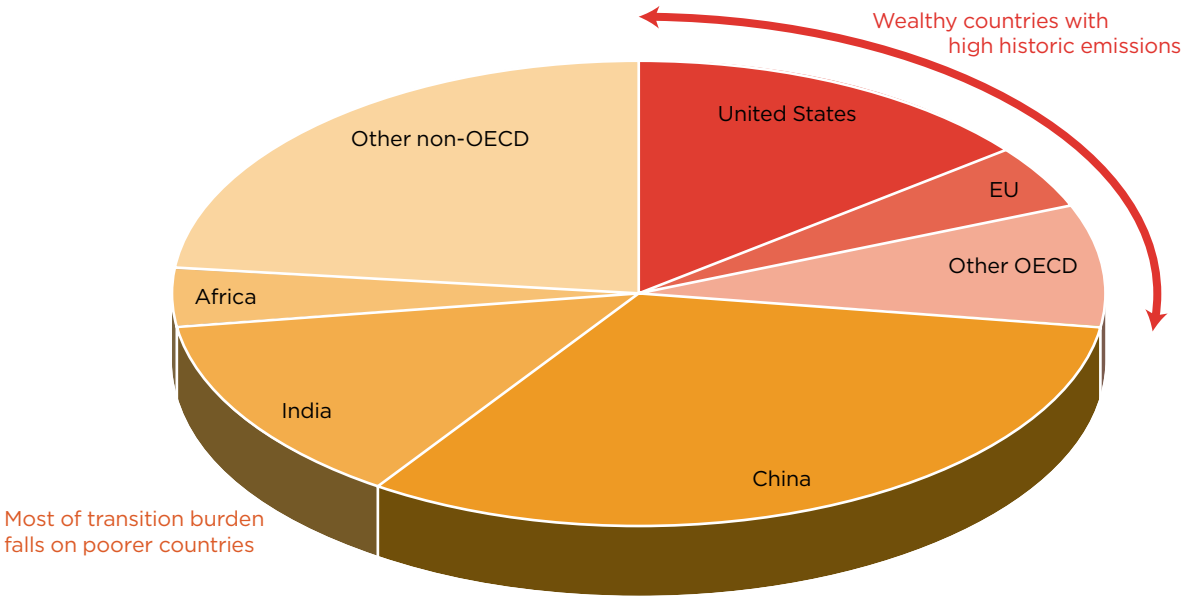
In some cases, the IEA promotes fossil fuel combustion as well as supply. One of the earliest and longest-running projects housed by the IEA is the Clean Coal Centre, which promotes coal as part of the energy mix, arguing that "We must not ignore an important energy source but invest in making it cleaner."[183] However, today carbon budgets are so depleted that there is no role for coal, whether supercritical, scrubbed, or otherwise. The discussion today among investors, governments, regulators, and civil society is not about whether the energy system should be electrified and powered by 100 percent renewable energy, but how soon that goal can be achieved.

The Clean Coal Centre does not stop at arguing for cleaner coal, but advocates for coal more generally – for example it promoted coal as the "best way forward" for developing countries, and characterized the G7's 2015 statement targeting zero fossil fuels by 2100 as something between "a widely optimistic dream" and "a draconian nightmare."[184] The Centre has also argued for a weakening of regulations designed to reduce emissions of sulfur oxides, nitrogen oxides, particulates, and mercury (which is ironic, given its name).[185]

The IEA's Coal Industry Advisory Board also promotes the burning of coal. A 2015 report by the CIAB on the socioeconomic impacts of coal power stations failed to mention climate change, and only briefly addressed health impacts.[186] Tim Buckley of the Institute for Energy Efficiency and Financial Analysis described the report as "a litany of errors and false assumptions, clearly written ultimately as a disinformation tool." When contacted by The Guardian newspaper, the IEA disowned the report, although its title page says, "International Energy Agency, Insights Series 2015."[187]

p CIAB's current members are 24 coal mining or coal power companies and five trade associations

Figure 15: 2040 Emissions Cuts in SDS Compared to NPS, OECD and Non-OECD countries



Source: IEA[192]

As we have noted, the IEA plays a positive role in supporting and enabling clean energy technological development. The theory is that as those technologies improve, they will be better able to compete with fossil fuels. Unfortunately, the IEA undermines these efforts by also investing in making fossil fuel technologies cheaper and more effective, through a number of programs overseen by its Working Party on Fossil Fuels. In 2013 the IEA founded the Gas and Oil Technology Cooperation Programme, which aims to enhance development of extraction technologies, with a focus on unconventional oil and gas and drilling in the Arctic.[188]

The IEA also works to influence regulation in favor of fossil fuels. In 2012 the IEA established the Unconventional Gas Forum, which aims "to enable decision makers around the globe to make informed decisions on operational best practices and regulatory action to secure the economic, security and other benefits of increased unconventional gas output."[189]

The 2017 *World Energy Outlook* tried to resolve the climate-versus-fossil fuels tension by dedicating a chapter to making an "environmental case for natural gas". The centerpiece of the analysis is the idea that the leakage of methane can be reduced to acceptable levels at little to no cost to oil and gas producers. However, even the IEA data shows that implementing the leakage reductions it advocates for would reduce temperature rise by only 0.07 degrees Celsius, compared to its core pathway of change more than to around 3 degrees Celsius.[190] The most generous interpretation is that as a climate solution, the IEA's gas proposal is hopelessly inadequate – precisely because it costs nothing economically to the fossil fuel companies or politically to governments.

The IEA was originally created as an institution to support the smooth flow of fossil fuels to wealthy consuming countries. While it has taken some important steps on clean energy and climate change, it cannot effectively help governments address the climate challenge while remaining wedded to fossil fuels.

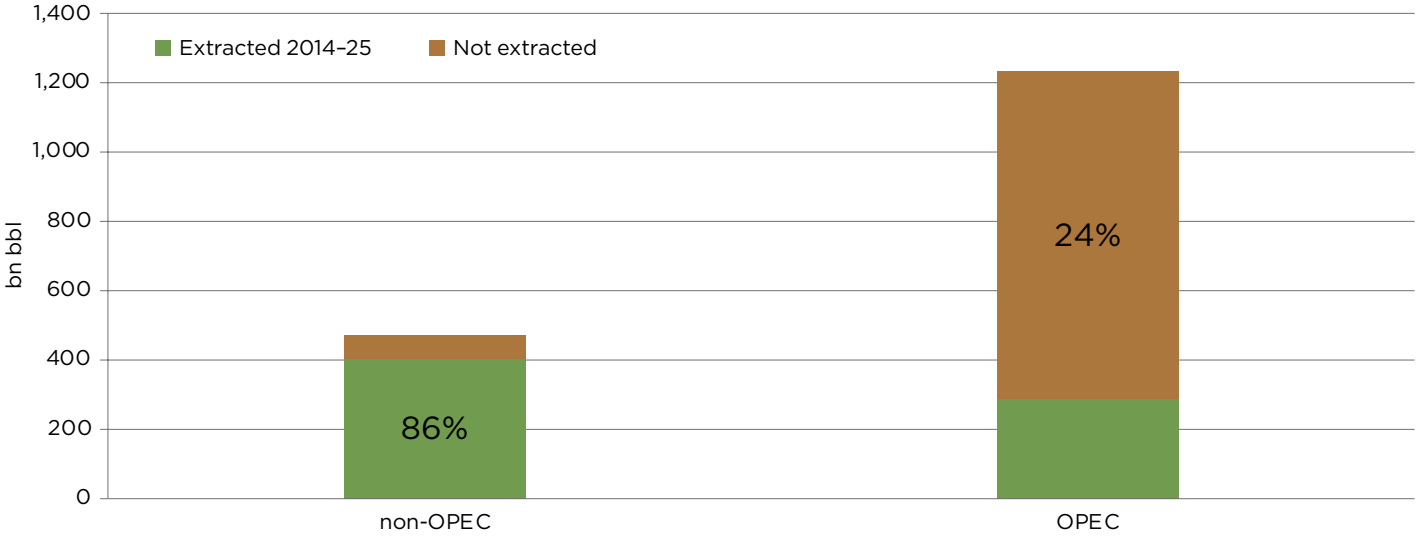
PLACING THE BURDEN ON DEVELOPING COUNTRIES

Climate change is a tragedy of the commons, and as a result, the self-interest of different players leads to an expectation that others should carry the burden of transformation. One of the steepest barriers to achieving an effective global solution is that some industrialized countries have refused to accept their greater responsibility for causing the problem and the benefits they have gained from past emissions. They have argued that rather than address absolute levels of emissions (let alone wealth), all countries should reduce emissions by the same percentages from a common baseline year.

The IEA – all of whose members are also members of the OECD – exacerbates this political dynamic. The SDS assumes that the majority of emissions cuts from a business-as-usual trajectory will be in developing countries, as shown in Figure 15. As an example, in spite of its pressing development needs, India is expected to cut its 2040 emissions by 46 percent compared to the NPS, while the European Union is expected to cut its emissions by only 40 percent.[191] As the IEA deepens its relationship with major developing countries through its associate membership scheme, these countries may object to the IEA's unjust allocation of effort-sharing.

Passing the burden to developing countries is problematic from a climate equity standpoint. Enshrined within the UNFCCC –which all IEA members are party to – is the principle that countries should act according to their "Common but Differentiated Responsibilities and Respective Capabilities." This means the greatest efforts to address climate change should be made by the countries that did the most to cause the problem and that have the greatest resources available to devote to it. In both respects, this points to wealthier countries.

Figure 16: Share of OPEC and Non-OPEC Reserves Extracted 2014-35 in the 450 Scenario



Source: IEA[194]

An equity problem appears with fossil fuel supply, too. The IEA tends to assume it is non-IEA members that will bear the greatest burden. While recognizing that the world's fossil fuel reserves well exceed what can be burned within climate limits, the IEA squares this with its call for more investment in ever-greater supply by assuming that the reserves of IEA members and their corporations can be fully extracted, while much of the reserves of OPEC countries will be unburnable (see Figure 16). While it is true that OPEC countries generally extract their reserves more slowly than non-OPEC countries, the IEA assumes that OPEC's share of global production will not increase from the current 42 percent when reserves elsewhere become costlier – a somewhat implausible assumption, both on a cost basis and given that OPEC countries possess an increasing majority of the world's remaining reserves.

And as we have seen, these projected allocations are also driving fossil fuel supply. The IEA's suggestion that non-OPEC reserves can be fully extracted has been used by Canada's environmental regulator to infer that the Albertan tar sands can be fully extracted without exceeding emissions limits, and therefore to recommend approval of new pipelines.[193]

The result is a politically convenient finding for IEA members, as the burden of emissions reduction is disproportionately borne by non-IEA members. As a result, the IEA's climate scenario calls for less change (and more consumption and production of fossil fuels) in IEA countries than would occur with more balanced assumptions.

7. RECOMMENDATIONS

The *WEO* states:

"Our aim is to illuminate and inform debate and decision-making. If the projections in our Current Policies Scenario [CPS] or even our New Policies Scenario [NPS] turn out to be true in 2040, this will not be a sign of success. Success for the WEO is about helping countries to achieve the long-term energy and related goals that they have chosen."[195]

Yet the IEA's heavy focus on the NPS instead steers the world towards what the IEA acknowledges is failure. If the IEA wants to support governments in achieving their energy goals, it should make the goal-based scenario the main one in the report: the focus of the narrative, the data tables, and the communications, in the way that the NPS is presented currently. Decisions informed by the *WEO* would then take us towards our climate goals, rather than further away from them. The NPS could then be included as a secondary, comparative scenario to illustrate the policy gap and show how much additional action is needed.

We recommend the IEA adopt a three-pronged approach to reform:

- **Plan for Success:** Focus the *WEO*'s **main scenario** – including the majority of the narrative and the main data tables – on internationally-agreed policy goals on climate, energy access, and air pollution.

- **Respect Paris Goals:** Align that main scenario with the Paris Agreement goals of keeping warming *well below* 2 degrees Celsius, and pursuing efforts to keep it to 1.5 degrees Celsius:

    - This could be done by showing a range, from being aligned with a 66 percent chance of 2 degrees Celsius to a 50 percent chance of 1.5 degrees Celsius;

    - Alternatively, there could be a single scenario with a high probability (say, 80 or 90 percent) of staying below 2 degrees Celsius;

    - The scenario should be transparent about reliance on any unproven technologies such as carbon capture and storage or negative emissions, and should show how the scenario would look without such technology assumptions; and

    - There should also be full transparency about potential conflicts of interest: The IEA should publicly disclose any company involvement in the *WEO* or other information product, whether through staff secondment, data provision, or other means.

- **Illustrate Gaps**: Include the NPS as a minor, **comparative scenario** explicitly to show where action is needed, rather than characterizing its findings as a future to prepare for and shape investments and policy decisions around. Drop the CPS, which is now largely redundant.

For users of the *WEO*, we recommend that governments, companies, and investors avoid basing their decisions on scenarios such as the NPS that would lead to severe climate change, and instead plan for a safe climate future. They should also treat the SDS with caution, as it is not aligned with the Paris goals.

Until the *WEO* has been reformed, investors should stress-test their decisions against multiple futures by focusing on particular drivers, such as rapid renewable energy growth or an oil price crash.[196] There are growing numbers of forecasts focused specifically on clean energy, such as from BNEF and IRENA. Though they do not aim for a specific climate goal, these forecasts give a more genuine picture of potential energy industry disruption due to renewables than the IEA's offerings.

While in theory energy decision makers can conduct their own scenario analyses or commission them, the IEA's history and international profile give it an important ability to provide consistent, credible, and respected analysis at a global scale. We therefore recommend that governments and investors engage with the IEA to advocate for it to light the path to a clean energy future.

RECOMMENDATIONS FOR LONGER-TERM REFORM OF THE IEA

We saw in Section 6 that the IEA is heavily influenced by the fossil fuel industry. This is particularly true in the production of the *WEO*, a fact which undermines the IEA's role as an impartial adviser on energy systems. We have noted that the IEA does much positive work on climate change and clean energy, but also outlined ways in which the IEA's focus on fossil fuels makes it harder to achieve the Paris Agreement's goals. In part, this is because the IEA is torn between conflicting objectives on energy security and climate change.

In the medium to long term, both problems point to a need for reform and modernization of the institution. We recommend that the IEA's member countries:

- Clarify the IEA's objectives, such that all its activities are consistent with the Paris goals: For example, objectives on energy security and economic development should be specifically designed in relation to clean fuels that do not exacerbate the climate problem.

- Remove fossil fuel companies from the governance structures of the IEA, such as Governing Board and Ministerial meetings.

- Replace the Energy Business Council with a Climate and Energy Council, comprising climate scientists, civil society, and transition specialists; end the Coal Industry Advisory Board.

- Instruct bodies such as the Clean Coal Centre not to use the IEA name in publications that are not approved as IEA positions.

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159

(Gt CO_2)	IEA 66SFTS	More realistic
IPCC carbon budget	880	880
Minus non-fossil emissions	-90	-180
Fossil emissions budget	790	700
Minus post-2050 emissions	-80	-110
Pre-2050 fossil emissions budget	710	590
Plus pre-2050 CCS	+60	+0
Pre-2050 fossil extraction budget	770	590

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Oil Change International
714 G Street SE, Suite 202
Washington, DC 20003
www.priceofoil.org

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