global witness

OVEREXPOSED

HOW THE IPCC'S 1.5°C REPORT DEMONSTRATES THE RISKS OF OVERINVESTMENT IN OIL AND GAS

METHODOLOGY

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Our analysis compares data from the scenarios that inform the IPCC's report on 1.5°C and data from the consultancy Rystad Energy's UCube Database on production and investment in the upstream oil and gas industry.

DATA SOURCES

IPCC 1.5°C CLIMATE SCENARIOS DATA

The IPCC's report on 1.5°C is based on analysis of 90 climate scenarios that map out different pathways to achieve that goal. In late 2018, the data from these scenarios was published by the Integrated Assessment Modelling Consortium (IAMC), hosted by the International Institute for Applied Systems Analysis (IIASA).

Using this database, we excluded scenarios that had a high overshoot of the 1.5°C target before later reducing global temperatures. We selected those that had lower reliance on Carbon Capture and Storage (CCS) and Carbon Dioxide Removal (CDR) through Bioenergy with CCS (BECCS).

Five of the 90 scenarios met these criteria and included data on primary energy from oil and gas. For these five scenarios, we exported data for total primary energy from oil and gas for 2000-2050.

OIL AND GAS PRODUCTION AND INVESTMENT DATA

We sourced the data on historical and forecast oil and gas production and investment from Rystad Energy's UCube database. Ucube is a complete and integrated field-by-field database of the global upstream oil and gas market, including more than 65,000 oil and gas fields and licenses and covering the time span from 1900 to 2100. Rystad's data is widely cited by major oil and companies, the media and international bodies such as the IEA.

Oil production data includes crude oil, condensate, natural gas liquids and refinery gains; gas production includes natural gas; both excluding seasonal production, for the period 2000-2050. This data is segmented by the lifecycle of the underlying assets.

Factor	Criteria
Overshoot of 1.5°C	Scenarios categorised as no or low overshoot of 1.5°C target
Rate of growth of CCS and BECCS	Fossil CCS deployment in 2040 less than or equal to the International Energy Agency Sustainable Development Scenario 2040 Power CCS target of 1488 $MtCO_2$[1]
	BECCS deployment in 2040 less than or equal to the International Energy Agency Sustainable Development Scenario 2040 Power CCS target of 1488 $MtCO_2$
Ultimate scale of deployment of CCS and BECCS	Cumulative CCS deployment for 2016-2100 less than or equal to the mean for the low and no overshoot 1.5°C scenarios = 487 $GtCO_2$
	Cumulative BECCS deployment for 2016-2100 less than or equal to the mean for the low and no overshoot 1.5°C scenarios = 752 $GtCO_2$

Categorisation	Rystad lifecycle group	Rystad definition
Existing fields	Abandoned	Assets which have stopped producing or where production was suspended by owners
	Producing	All assets that are currently producing
	Under Development	Assets for which development has been approved by companies & government but production has not yet started (for North American shale assets, it includes the drilled uncompleted wells)
New fields	Discovery	Assets where discoveries have been made, but are not yet in a phase of further development (appraisal, field evaluation)
	Undiscovered	Assets where discoveries have not yet been made

The oil and gas investment data covered the same supply segments as the production data, for assets classed as Discovery or Undiscovered, and included;

- **Capex** - investment costs incurred related to development of infrastructure, drilling and completion of wells, and modification and maintenance on installed infrastructures; and,

- **Exploration capex** - costs incurred to find and prove hydrocarbons: seismic, wildcat and appraisal wells, general engineering costs, based on reports and budgets or modelled.

COMPARISON METHODOLOGY

The climate scenario data provides some challenges for use in a direct comparison with the Rystad data:

- There is considerable variation in the different models' historical and current data for energy from oil and gas, making them hard to compare to each other, and to the Rystad data.

- Data is only provided at 5 or 10 year intervals, a much lower level of disaggregation than the annual Rystad data. This means that the scenarios all project increases in production from 2019-2020, as this is included in the overall upward trend for the period 2010-2020 or 2015-2020.

To address these issues we used Rystad Energy's forecast of total production in 2020 as a baseline for our analysis as a single reference point across the two datasets. We then calculated the forecast annual rates of change from production from new and existing fields (Rystad data), and from primary energy from oil and gas (IPCC scenario data), and applied them to the 2020 baseline to produce directly comparable models of future oil and gas production.

LIMITATIONS

1. DEFINITIONS AND NON-ENERGY USES

As noted above, there are differences in the historical data for global energy from oil and gas, which may be indicative of different definitions used in those models for those measures. Our analysis has only used the final data from the IIASA IAMC database, so has not accounted for any differences in the underlying definitions used in those scenarios.

Our analysis has also compared scenario data for primary energy from oil and gas with production data, and this may underplay the future role of non-energy usage of oil and gas. It is not clear to what extent the scenarios account for non-combustion uses of oil and gas in the data on primary energy – though it is worth noting that total energy from oil and gas in the scenarios is roughly comparable with total energy from current oil and gas production. Our analysis has also not assessed the extent to which the IPCC scenarios account for methane leakage from oil and gas production.

A more comprehensive analysis would need to ensure any differences in definitions between the climate scenarios are addressed, and that further consideration is given to future oil and gas demand for non-combustion uses, such as the petrochemicals industry, as well as methane leakage. The IEA has produced models of what a 2°C scenario could mean for the petrochemicals industry, but we are not aware of a similar 1.5°C scenario for petrochemicals.

2. SCENARIO SELECTION AND MODELLING FUTURE CCS AND CDR DEPLOYMENT

The criteria used for excluding high CCS and BECCS scenarios are arguably arbitrary. As noted in the report, there are no credible forecasts for the development of CCS and BECCS / CDR over the period of the scenarios (up to 2100). Even the shorter-term targets that do exist, e.g. the IEA's SDS targets, are not reflective of current trends, given that the IEA reports the world is "off-track" on achieving these targets.

Scenarios with realistic forecasts for the future deployment of CCS and BECCS / CDR based on current trends, policies and levels of investment are urgently needed. The data from such scenarios should then be used to identify and develop climate scenarios with comparable levels of CCS and BECCS / CDR deployment.

3. PRICE EFFECTS ON FORECAST PRODUCTION FROM EXISTING FIELDS

The data for forecast production from existing fields is based on Rystad's base case scenario. As such, it does not account for the lower production that would be expected from these fields in a lower price environment that would likely be the case if demand fell in line with that level of production (as would be expected in a classic supply-demand price relationship).

As a result, our analysis overestimates production from these fields, as we have not attempted to quantify those price impacts. However, we believe that considering the price impact is unlikely to change the overall findings significantly. Using a lower price scenario of $50/barrel, Rystad only forecasts a 2% reduction in oil and gas production from these fields compared to the base case scenario over the period 2020-2029.[1]

4. VARIATION IN COST OF SUPPLY FROM NEW FIELDS

The calculation of the percentage of capex that is compatible with each scenario was determined by the percentage of production new fields that would meet demand in that scenario. This approach assumes a direct relationship between capex and production. As it does not account for the varying costs of supply it is likely that the amount of capex that is compatible with these scenarios is lower, as it would be likely that only lower cost projects would be sanctioned.

5. REGIONAL GAS MARKET DYNAMICS

Gas markets are more regional than oil, including greater regional price variability. Our analysis has only looked at gas production at the global level and has not sought to break this down by region – therefore our analysis may not fully account for geographic shifts in production, demand, and prices that may have an impact on the overall investment landscape.

6. CHALLENGING ASSUMPTIONS IN THE SELECTED SCENARIOS

The purpose of this analysis is to analyse the extent to which forecast oil and gas production is compatible with limiting warming to 1.5°C without relying heavily on carbon capture and removal. However, it is worth noting that the scenarios that met the inclusion criteria for our analysis also make other challenging assumptions about the energy transition. These include some relying on large long-term reductions in total global energy demand or very significant increases in global carbon prices. A more detailed model could look at all of the variables and parameters of the 1.5°C scenarios to identify those that best reflect the most probable range of assumptions across all parameters.

7. USING A MEAN OF SELECTED SCENARIOS

The mean of the five selected scenarios provides an illustration of average oil and gas demand across the low CCS low BECCS scenarios. However, in doing so, this obscures differences between the five scenarios that reflect some of the different potential socioeconomic and political pathways and options that exist within a low CCS and low BECCS future. As a result, while it produces a useful picture of demand across those scenarios it is not an actual scenario.

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[1] Rystad Energy UCube – Comparison of production volume under base case and low case scenarios, excluding unsold gas, 2020-2029, life cycle category = abandoned, producing, under development.

Overview of selected lower CCS and BECCS 1.5°C scenarios

	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E
Model	POLES EMF33	MESSAGEix-GLOBIOM 1.0	POLES EMF33	POLES EMF33	POLES EMF33
Scenario	EMF33_1.5°C_limbio	LowEnergyDemand	EMF33_WB2°C_none	EMF33_WB2°C_nobeccs	EMF33_WB2°C_limbio
Category	Below 1.5°C	1.5°C low overshoot	1.5°C low overshoot	1.5°C low overshoot	1.5°C low overshoot
Median warming at peak	1.47	1.53	1.52	1.52	1.56
Year of peak warming	2033	2048	2040	2040	2049
Cumulative CO2 emissions (2016-2100, Gt CO2)	205.5	548.7	713.6	717.5	705.2
Cumulative CCS (2016-2100, Gt CO2)	268.1	0	88.0	102.3	503.2
Cumulative BECCS (2016-2100, Gt CO2)	242.2	0	0.03	0.03	358.0
Cumulative sequestration land-use (2016-2100, Gt CO2)	0	246.4	0	0	0