Implications of the International Energy Agency Net Zero Emissions by 2050 Scenario for Net Zero Committed Financial Institutions

Briefing Paper

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Oxford Sustainable Finance Group, Smith School of Enterprise and the Environment, University of Oxford

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Aligning finance with sustainability is a necessary condition for tackling the environmental and social challenges facing humanity. It is also necessary for financial institutions and the broader financial system to manage the risks and capture the opportunities associated with the transition to global environmental sustainability.

The University of Oxford has world-leading researchers and research capabilities relevant to understanding these challenges and opportunities. Established in 2012 the Oxford Sustainable Finance Group is the focal point for these activities. The Group is multidisciplinary and works globally across asset classes, finance professions, and with different parts of the financial system. We are the largest such centre globally and are working to be the world's best place for research and teaching on sustainable finance and investment.

The Group is based in one of the world's great universities and the oldest university in the English-speaking world. We work with leading practitioners from across the investment chain (including actuaries, asset owners, asset managers, accountants, banks, data providers, investment consultants, lawyers, ratings agencies, stock exchanges), with firms and their management, and with experts from a wide range of related subject areas (including finance, economics, management, geography, data science, anthropology, climate science, law, area studies, psychology) within the University of Oxford and beyond.

Since our foundation we have made significant and sustained contributions to the field, including in some of the following areas:

- Developing the concept of "stranded assets", now a core element of the theory and practice of sustainable finance.
- Contributions to the theory and practice of measuring environmental risks and impacts via new forms of geospatial data and analysis, including introducing the idea and importance of "spatial finance" and "asset-level data".
- Shaping the theory and practice of supervision as it relates to sustainability by working with the Bank of England, the central banks' and supervisors' Network for Greening the Financial System (NGFS), and the US Commodity Futures Trading Commission (CFTC), among others.
- Working with policymakers to design and implement policies to support sustainable finance, including through the UK Green Finance Taskforce, UK Green Finance Strategy, COP26, and the high-level Transition Plan Taskforce.
- Nurturing the expansion of a rigorous academic community internationally by conceiving, founding, and co-chairing the Global Research Alliance for Sustainable Finance and Investment (GRASFI), an alliance of 30 global research universities promoting rigorous and impactful academic research on sustainable finance.

The Global Sustainable Finance Advisory Council that guides our work contains many of the key individuals and organisations working on sustainable finance. The Oxford Sustainable Finance Group's founding Director is Dr Ben Caldecott.

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Implications of the International Energy Agency Net Zero Emissions by 2050 Scenario for Net Zero Committed Financial Institutions

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Executive Summary

In 2021, the International Energy Agency (IEA) published the Net Zero Emissions by 2050 Scenario (IEA NZE) consistent with holding the increase in the global average temperature to 1.5 degrees above pre-industrial levels. The roadmap in the IEA NZE provides clear milestones for the future role of fossil fuel energy.

First, apart from projects already in existence or approved for development in 2021, the development of new oil, natural gas, and coal reserves is not required. As a result, upstream oil & gas capital expenditure (CAPEX) falls sharply as production winds down, with upstream investment limited to existing reserves and fields approved for development in 2021.

Second, in power generation, overall net zero emissions electricity is achieved by 2035 in advanced economies and by 2040 globally. This requires no additional coal power stations, with generation from unabated plants phased out by 2030 in advanced economies and by 2040 globally. In the G7, unabated gas power generation is reduced by 93% by 2035 from 2020, accounting for just 2% of total generation. By 2040 generation falls by 96% and accounts for 0.8% of generation. Globally, unabated natural gas power generation falls by 90% by 2040, accounting for 1.1% of total generation, while capacity falls at a slower rate of 63% by 2040. As remaining generation is focused on providing reserve power and grid flexibility, sharp falls in capacity utilisation occur. Gas with carbon capture overtakes unabated gas power generation by 2040 but is equivalent to only 11% of unabated gas generation in 2020.

However, these milestones on the route to net zero are at odds with the current trajectory of our energy system, with significant expansion planned in both fossil fuel reserves and fossil fuel power. They are also at odds with the financial flows supporting this expansion, despite financial institutions with $130 trillion in assets committing at COP26 to align their portfolios with net zero by 2050.

The purpose of this briefing is to examine the implications of the IEA NZE for these financial institutions and to identify corresponding changes to fossil fuel financing policies. To do this, the conclusions of the IEA NZE for fossil fuel production are reviewed, focusing on the ability of existing reserves to meet demand to 2050. For fossil fuel power generation, the changes in the IEA NZE for the generation and capacity for natural gas and coal power are considered.

For fossil fuel production, financial institutions need to:

- End project finance for the development of new fossil fuel reserves not approved for development as of 2021.
- To be eligible for corporate finance and underwriting, require companies to implement transition plans ending the expansion of new fossil fuel reserves if not approved for development as of 2021, with production then reduced over time as existing reserves are utilised.

For fossil fuel power generation, financial institutions need to:

- End project financing for new coal-fired power generation.
- To be eligible for corporate finance and underwriting, require companies to implement transition plans ending the expansion of coal-fired power generation, with existing generation phased out by 2030 in advanced economies and 2040 in the rest of the world.
- Require companies to detail and implement transition plans to reduce unabated gas generation in line with IEA NZE phase out dates, falling in absolute terms from 2025 and by over 90% by 2040.

Next, through illustrative case studies, the disconnect between current financing activity and the conclusions of the IEA NZE is demonstrated. This is achieved by analysing the financing activity of one investment bank (Barclays) and one asset manager (BlackRock ETFs). Using the World Electric Power Plants (WEPP) database from S&P and the Global Oil & Gas Exit (GOGEL) database from Urgewald List, the energy mix of power generation companies financed and the exploration activities of oil & gas companies financed is tracked. We also provide an overview of the fossil fuel financing policies of development banks.

For the companies financed in the illustrative case studies, 12% of gas capacity is under 10 years in age and between 9% (BlackRock) and 29% (Barclays) of coal capacity is under 20 years in age. In terms of expansion, new gas assets under construction or planned represent a growth in capacity of approximately 10%. For fossil fuel production, the case studies show that oil & gas companies financed are continuing to expand fossil fuel reserves, allocating approximately 10% of CAPEX to exploration related activities.

As new fossil fuel power generation assets often have operational lives of 30-40 years, there is an urgent need to implement financing policies consistent with net zero by 2050 to reduce stranded asset risk and carbon lock-in. Given IEA NZE phase-out dates, this requires an immediate end to financing for coal-fired power expansion, and a rapid phase-out of existing generation. While unbated gas-fired power continues to have a reduced role in the IEA NZE as a source of reserve power, generation and capacity fall sharply after 2030 relative to 2020 levels, requiring a reduction in financing for new gas power.

These findings make clear the need for companies to develop credible transition plans aligned with net zero, and for financial institutions to make them a pre-requisite for financing. Yet, at present, neither Barclays nor BlackRock require companies financed to halt coal power expansion or have transition plans to fully phase out generation in line with IEA NZE phase out dates. While many financial institutions have developed policies to address the financing of coal, few have addressed fossil fuel reserve expansion, or the need to reduce financing for unabated gas. For financial institutions committed to net zero by 2050, these policies need to be developed and implemented. Passive funds, and use of proceeds financing such as green bonds, cannot be carved out from these policies.

The energy transition brings opportunities for financial institutions, given the vast amount of capital needed for low-carbon energy and supporting infrastructure. In addition, financial institutions are able to support high-carbon companies in their transition. However, delivering this in a manner consistent with net zero commitments requires transparent and science-based financing policies. Developing these policies is the objective of this briefing paper. The recommendations made for financing policies are not exhaustive, but focused on fossil fuel expansion and the IEA NZE.

1. Introduction: A Framework for Net Zero Financing

Ahead of COP26, the UK Presidency requested that the IEA develop a roadmap for reaching net zero emissions by 2050 (IEA, 2021c). In response, the IEA developed the Net Zero Emissions by 2050 Scenario (IEA NZE), showing a pathway to net zero CO2 emissions from the energy sector by 2050 with a 50% probability, in line with IPCC recommendations (IPCC, 2018). In addition, in the IEA NZE cuts to emissions by 2030 are in line with IPCC pathways with limited or no overshoot with respect to 1.5C of warming.

Transforming the energy system at the pace required in a 1.5C scenario will require a corresponding step change in investment in low-carbon technologies and supporting infrastructure. For example, in the IEA NZE, investment in electricity generation rises from $0.5 trillion per year in 2021 to $1.6 trillion in 2030, of which renewables account for $1.3 trillion (IEA, 2021b, p. 81). Similarly, investment in low-carbon energy infrastructure (including networks, EV charging, and pipelines) rises from $0.3 trillion in 2021 to $0.9 trillion in 2030 (IEA, 2021b, p. 82).

Meeting the requirements of this “decade of delivery” depends on the ability of financial institutions and policymakers to mobilise capital. But this alone is not sufficient. High-carbon investment must also be phased out. In the IEA NZE, investment in upstream oil & gas falls from $575 billion per year in 2020 to $110 billion in 2050 (limited to existing fields) (IEA, 2021b, p. 81). Similarly, for electricity generation, investment in fossil fuel power without CCUS drops from $131 billion per year to $36 billion (IEA, 2021b, p. 82).

At COP26, the Glasgow Financial Alliance for Net Zero (GFANZ) brought together financial institutions representing $130 trillion in assets committed to aligning their activities and portfolios with net zero emissions by 2050 (GFANZ, 2021). In doing so, these financial institutions face a challenge. While new entrants drive innovation, incumbent energy companies have a crucial role in the net zero transition given their scale and skills. But if incumbent energy companies continue to develop fossil fuel assets at the current rate, this will lead to carbon lock-in and stranded assets (Caldecott, 2018; Pfeiffer, Hepburn, Vogt-Schilb, & Caldecott, 2018; Saygin, Rigter, Caldecott, Wagner, & Gielen, 2019).

Therefore, financial institutions need to support carbon-intensive companies to transition, but only in a manner consistent with net zero commitments. Striking this balance and translating long-term targets into the present requires financial institutions to develop transparent polices outlining what is eligible for financing. This briefing focuses on one element of these policies: financing fossil fuel expansion in the energy sector.

This briefing is structured as follows. In Part 1, the findings of the IEA NZE for fossil production and generation are summarised. In Part 2, the implications for financing policies are discussed. In Part 3, case studies are provided, exploring the compatibility of financing by banks and asset managers with the IEA NZE conclusions. When discussing the implications for financing policies, the following high-level principles are applied:

1. Focus on Capital Flows

Capital allocation is identified as one of three mechanisms for financial institutions to generate "impact", alongside engagement and indirect impacts (Kölbel, Heeb, Paetzold, & Busch, 2020). These different mechanisms demonstrate the trade-off between divestment and engagement (Braungardt, van den Bergh, & Dunlop, 2019). To address this, one can distinguish between capital allocation in primary and secondary markets.

In primary markets, new financial securities are issued, while in secondary markets, existing securities are traded. Therefore, it is through primary markets that capital flows from the financial system to the real economy, directly supporting the construction and operation of energy infrastructure (Wilson & Caldecott, 2021). Financing policies that restrict high-carbon investment should first and foremost focus on equity and debt primary markets, encompassing both corporate finance, project finance, and underwriting.

With regard to secondary markets, financial institutions need to carefully consider whether engagement activities generate sufficient "impact" to offset the benefits of providing liquidity and demand for securities. This is not an exact science. In equity markets, enhanced investor engagement and stewardship using secondary market holdings can influence companies' internal capital allocation decisions. Engagement activities within debt markets are less established but can also be effective. However, financial institutions need to ensure that engagement is robust and timebound, as secondary market demand can reduce the cost of capital in debt primary markets, where the majority of fossil fuel finance is provided (Cojoianu, Ascui, Clark, Hoepner, & Wójcik, 2020; Goldstein, Hotchkiss, & Pedersen, 2019; Wilson & Caldecott, 2021).

2. Use Transparent Science-Based Scenarios

If policies dictate which activities can be financed and when, to ensure they are credible, the use of science-based pathways or scenarios is required. IEA scenarios are not the only option, but are already used for this purpose by financial institutions as a common point of reference. For example, nine of the 25 largest European banks use either Sustainable Development Scenario (SDS) or Beyond 2 Degrees Scenario (B2DS), giving a 50% chance to limit warming to below 1.65C and 1.75C respectively, for portfolio target setting (ShareAction, 2021).

Financial institutions committed to reaching net zero by 2050 need to update financing policies in line with the IEA NZE or an alternative that will limit the increase in the global average temperature to 1.5 degrees. The IEA NZE represents one of many possible paths to net zero emissions by 2050, with pathways dependent on, among other factors, the pace of technological change, the availability of resources, and the willingness of populations to change behaviour. If alternative scenarios are used, transparency is key, to ensure that stakeholders can scrutinise the basis on which policies are developed.

3. Apply the Precautionary Principle

Although IEA scenarios provide valuable insights for governments, companies, and civil society, they have historically underestimated the falling costs of renewables (Way et al., 2021). These challenges are not limited to the IEA, but are inherent in economic modelling methods such as Integrated Assessment Models that struggle to capture the dynamics of non-linear change that characterise the low-carbon transition (Farmer, Hepburn, Mealy, & Teytelboym, 2015).

The climate, economic, and financial systems are complex systems, with tail risks and tipping points (Chichilnisky, Rezai, Hepburn, & Farmer, 2020). Climate-related risks, therefore, differ from typical financial risks due to long-time horizons, a lack of historical precedent, irreversible consequences, and endogeneity and path dependency (Chenet, Ryan-Collins, & van Lerven, 2019). Capturing this non-linearity within and between systems is a major challenge for IAMs, which can result in an underweighting of the future impacts of climate change, with a gradual policy response seen as optimal over stronger short-term climate policies (Chichilnisky et al., 2020).

When faced with the radical uncertainty of climate change and associated modelling challenges, the “precautionary principle” can be applied (Chenet et al., 2019). This requires a market-shaping approach to be taken, whereby policymakers actively steer the market onto an optimal pathway to minimise long-term systemic risks. This logic can be extended beyond regulators to financial institutions themselves, who can seek to “create their preferred scenario” through collective action, rather than taking action to just minimise their climate-related risk exposure.

Applying the precautionary framework requires preventative measures regarding “undesirable economic activities” (Chenet et al., 2019). Within the context of the low-carbon transition, this requires an end to the expansion of activities incompatible with a 1.5C scenario, such as coal power. Furthermore, financial institutions need to be cautious about relying on future technologies with uncertain commercial viability — natural gas power expansion dependent on future carbon capture and storage, for example.

This change in approach requires financial institutions to move beyond “climate risk management” to “alignment with climate outcomes” (Caldecott, 2020a). This is akin to acting as “universal

owners". These are financial institutions with broad-based portfolios, making them more dependent in the long-term on the performance of the overall economy than any specific company or sector (Schoon, 2011). As a result, activities that may be profitable in isolation (e.g. fossil fuel production) may be negative for the overall portfolio due to negative externalities (e.g. carbon emissions) (Dimson, Kreutzer, Lake, Sjo, & Starks, 2013). As discussed in Principle 1, in practical terms this requires a decarbonisation mandate in primary markets and targeted engagement in secondary markets (Quigley, 2019).

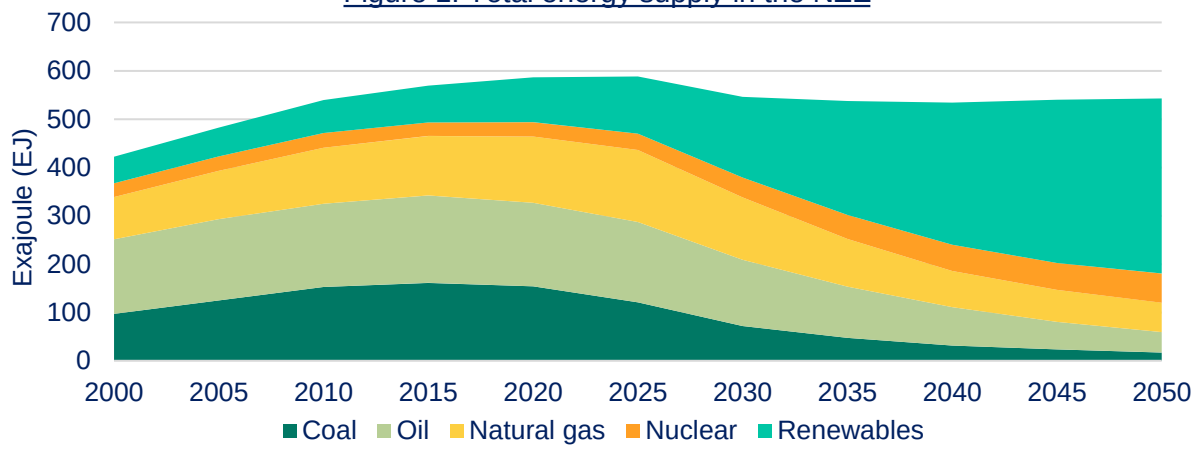
A challenge in adopting this approach is that while the most severe impacts of climate change will be felt in the long-term, financial institutions typically have short-term time horizons (Carney, 2015). For example, asset managers may aim to minimize quarterly fund tracking error, or banks may aim to top annual league tables. For financial institutions to deliver on their net zero commitments, they need to look beyond these short-term time horizons.

2. Fossil Fuel Energy in the IEA NZE

This part of the briefing identifies the drivers of falling fossil fuel demand and the key elements of the IEA NZE regarding fossil fuel production, covering oil, natural gas, and coal, and fossil fuel power generation, focusing on natural gas and coal.

2.1. Drivers of a Net Zero Energy System

Figure 1: Total energy supply in the NZE



In the IEA NZE, driven by electrification, energy efficiency improvements, and behaviour change, renewables and nuclear power displace fossil fuels as the dominant source of energy, with their

share in the energy mix rising from 20% to 80% from 2020 to 2050, as shown by Figure 1. These dynamics are summarised below:

- Electrification: within global energy consumption, the share of electricity in the energy mix rises from 20% in 2020 to 50% in 2050. For example, within transport, the share of electricity in energy consumption rises from 1.5% in 2020 to 45% in 2050, while heat pumps installation results in electricity accounting for 66% of energy consumption in buildings by 2050. In heavy industries, the role of electricity in heat production also rises, with the proportion of steel produced with an electric arc furnace rising from 24% to 53%.
- Energy efficiency: the key to keeping energy consumption stable, despite growing populations and economies, is improvements in energy efficiency. These improvements play their most major role from 2020 to 2030. For example, 2.5% of existing buildings are retrofitted each year with energy efficient heating, while transport fuel standards reduce emissions from heavy-duty road vehicles.
- Behaviour change: in the IEA NZE, 55% of emission reductions include the deployment of low-carbon technologies that require the participation of citizens or consumers by, for example, installing a heat pump or buying an electric vehicle. A further 8% arise from consumer choices that reduce energy demand from existing technologies, such as saving energy usage in houses, reducing flying, and recycling.
- Development and deployment of low-carbon energy: the doubling in electricity demand that occurs in the IEA NZE is primarily met by a rising share of renewables, increasing from 29% in 2020 to 90% in 2050. This growth is met by wind and solar with support from dispatchable hydropower and bioenergy. In sectors where electrification is challenging, such as heavy industry or transport, low-carbon fuels play a critical role. For example, low-carbon hydrogen provides 60% of fuel consumption in shipping by 2050. Bioenergy also plays a critical role in displacing fossil fuels in harder-to-abate industries, both as a fuel (e.g. in aviation) and for heat generation in industry (e.g. cement production).

2.2. Fossil Fuel Production

Combined, these drivers result in a sharp drop in the demand for fossil fuels in the IEA NZE. However, Figure 1 shows ongoing residual demand, with fossil fuels accounting for 20% of energy supply in 2050. At this point, the majority of demand arises from chemicals, harder-to-abate industries, and hydrogen production. However, the IEA is clear that existing fossil fuel reserves are sufficient to meet this demand, as detailed below.

Oil:

- Oil demand falls 4% a year, falling from 88 mb/d in 2020 to 24 mb/d in 2050.
- To meet ongoing demand, existing reserves are sufficient, meaning that no exploration of further oil resources is required, and no development of new oil fields is required beyond those already approved for development as of 2021.
- Investment in existing oil production facilities or those approved for development continues. This will enable production to match falling demand.

Natural Gas:

- Natural gas demand falls 2.6% a year from 2020 to 2050, equivalent to 55%. Demand peaks in the mid-2020s at 4,300 bcm, falling to 3,700 bcm in 2030 and 1,750 bcm in 2050.
- No new gas fields are required apart from those currently being developed.
- Investment in existing natural gas production facilities or those approved for development continues. This will enable continued production to match falling demand.

Coal:

- Coal demand falls by 7% a year, falling from 5,250 mt in 2020 to less than 600 mt in 2050.
- No new coal mines or expansion of existing mines is required.
- Although demand for coking coal falls at a slower rate, current reserves are sufficient to meet demand to 2050.

2.3. Fossil Fuel Power Generation

Key to decarbonising the energy system in the IEA NZE is meeting increased electricity demand from low-carbon generation. Figure 2 provides an overview of global electricity generation in the IEA NZE, with wind and solar PV generation growing to account for 88% of electricity generation by 2050. This transition happens at different speeds, with advanced economies phasing out unabated fossil fuel power and fully decarbonising electricity generation in the 2030s, followed by developing economies in the 2040s. Table 1 provides more detail on the role of different technologies in the IEA NZE. This is summarised and discussed below for coal-fired power generation and gas-fired power generation.

Figure 2: Global electricity generation by source in the NZE

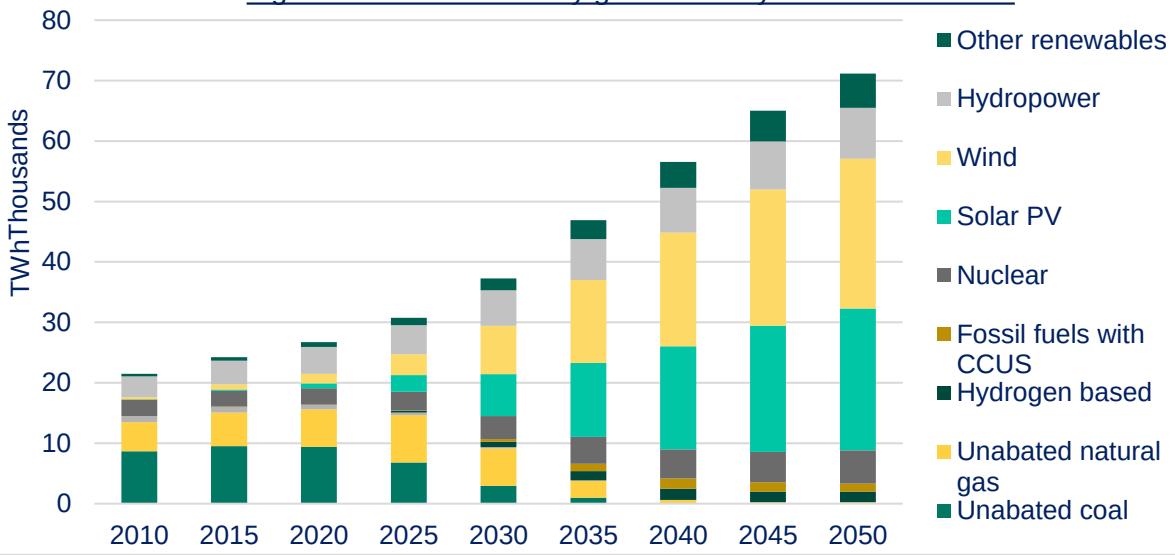


Table 1	Generation (TWh)				Capacity (GW)			
	2020	2030	2040	2050	2020	2030	2040	2050
Total	**26778**	**37316**	**56553**	**71164**	**7795**	**14933**	**26384**	**33415**
Coal	9426	2947	0	0	2117	1192	432	158
% Total	*35.2%*	*7.9%*	*0.0%*	*0.0%*	*27.2%*	*8.0%*	*1.6%*	*0.5%*
Coal + CCUS	4	289	966	663	1	53	182	222
% Total	*0.0%*	*0.8%*	*1.7%*	*0.9%*	*0.0%*	*0.4%*	*0.7%*	*0.7%*
Natural Gas	6200	6222	626	253	1829	1950	679	495
% Total	*23.2%*	*16.7%*	*1.1%*	*0.4%*	*23.5%*	*13.1%*	*2.6%*	*1.5%*
Natural Gas + CCUS	0	170	694	669	0	28	130	171
% Total	*0.0%*	*0.5%*	*1.2%*	*0.9%*	*0.0%*	*0.2%*	*0.5%*	*0.5%*
Oil	756	189	6	6	422	178	39	25
% Total	*2.8%*	*0.5%*	*0.0%*	*0.0%*	*5.4%*	*1.2%*	*0.1%*	*0.1%*

2.3.1. Coal-Fired Power Generation

- Unbated coal-fired powerplants are phased out globally by 2040 at the latest, with developed countries retiring all unabated coal power stations by 2030. The phase out of coal power begins immediately from 2020.
- While the share of generation from unabated coal falls to 0%, some residual capacity is maintained following a 93% drop in 2050 from 2020.
- Coal-fired power generation with CCUS grows from a low base, and obtains a higher share of generation than capacity relative to unabated generation, indicating higher capacity utilisation rates due to the prioritisation of lower carbon-intensity power.

The phase out dates of 2030 in advanced economies and 2040 globally are in line with studies using IPCC 1.5C scenarios (Climate Analytics, 2019). As the historical average operational life of coal power stations is 46 years globally, and approximately 60 in the US, 20 in China, and 50 in EU (Cui et al., 2019), new assets lives are incompatible with IEA NZE phase out dates, unless retrofitted. The IEA state that there are “no new investment decisions for the construction of coal-fired power in the NZE” (IEA, 2021d).

The average current age of coal power stations is approximately 40, 12, and 33 years respectively in the US, China, and EU (IEA, 2021d), meaning that many plants will reach the end of their operational life by 2030. However, to meet the reduction in coal power required in a 1.5C scenario, early retirement of coal assets is needed. In a 1.5C scenario, even if no new coal power stations are built, the existing global stock of assets will need to have their average operational life reduced to 20 years (Cui et al., 2019). If new plants currently under construction become operational, this is reduced by a further five years (Cui et al., 2019). This overcapacity is reflected in the WEO 2021, with generation from existing assets shown to be above that required not only in the IEA NZE, but also in the STEPS and APS scenarios aligned with 2.6C and 2.1C respectively (IEA, 2021d).

2.3.2. Gas-Fired Power Generation

- Generation using unabated natural gas rises in the short-term displacing coal in the energy mix and then falls from 2025, with generation in 2030 comparable to 2020. Generation is 90% lower by 2040 compared with 2020, and in 2050 is just 0.4% of the electricity mix.
- Unabated natural gas capacity also rises slightly by 2030 compared to 2020, but then falls sharply by 65% by 2040 and 75% by 2050, accounting for 1.5% of capacity.
- Natural gas with CCUS generation rises from 0% of the electricity mix to 0.5% in 2030, eventually reaching 0.9% by 2050.
- Relative to unabated natural gas, the share of abated generation is higher than capacity, indicating higher capacity utilisation rates due to the prioritisation of lower-carbon power in the energy mix.

Like coal, natural gas-fired power stations have long operational lifetimes. Taking a five year average of US data from 2014-2018, gas-powered gas turbines and combined-cycle units retired with operational lives of 32 and 33 years (S&P Global, 2019). Therefore, if current trends continue, new plants could have operational lives extending into the 2050s. Unlike coal, in the IEA NZE natural gas generation grows globally in the short-term until 2025. In advanced economies, natural gas generation is stable up until 2030, while in emerging market and developing countries, it

increases by around a third (IEA, 2021d). Following 2030, unabated natural gas power generation falls rapidly and is phased out in the 2040s, globally falling to almost 0% of the energy mix by 2050 (Figure 3). Considering the asset lifespans of new natural gas plants, the expansion of the natural gas power and associated financing appear incompatible with the IEA NZE requirement to decarbonise electricity generation in the 2040s and by 2035 in advanced economics.

Figure 3: IEA NZE - Global Gas-fired Generation

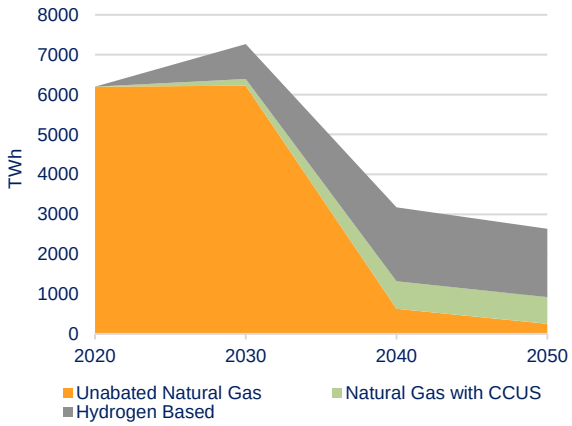
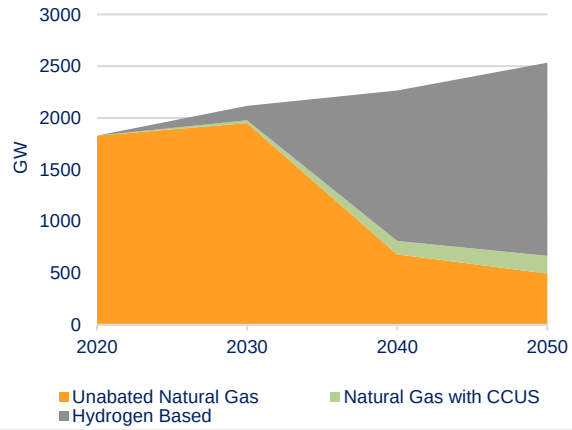


Figure 4: IEA NZE - Global Gas-fired Capacity

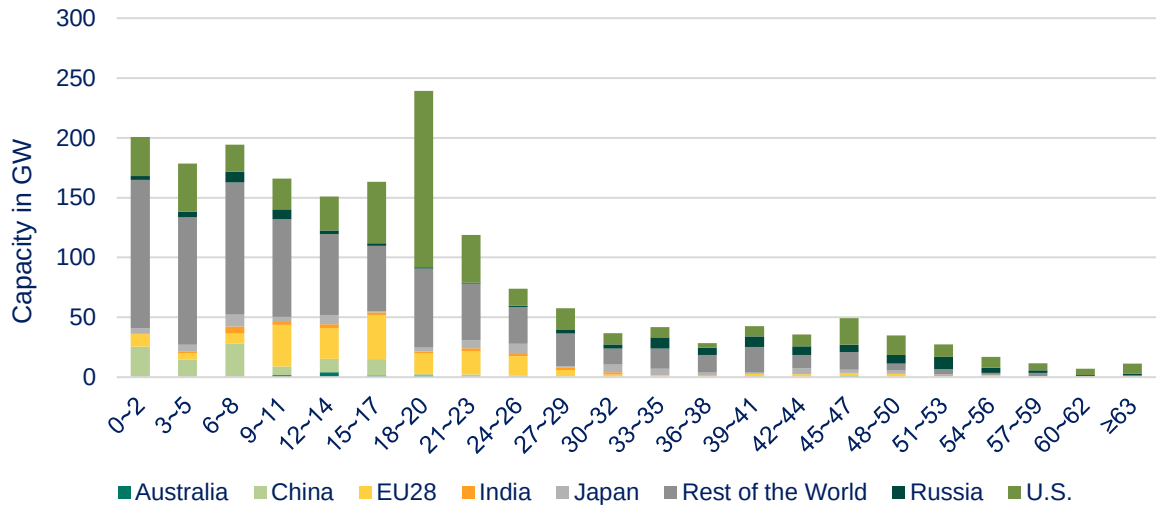


However, in the IEA NZE, unabated natural gas capacity falls at a slower rate than generation, with a reduction of 73% by 2050 compared to 96% (Figures 3 & 4). This is due to fact that natural gas power generation plays an important role in the IEA NZE as a source of reserve power and grid flexibility, offsetting intermittent renewables. This change in role results in a sharp drop in capacity utilisation. For example, in the G7, gas capacity factors (encompassing unabated and abated natural gas and hydrogen) fall from 40% in 2020 to 15% in 2050 (IEA, 2021a). Other sources of baseload and flexible generation include nuclear, hydro, and biomass. However, these are resource dependent or come with other environmental and social risks. Other solutions include battery storage and smart grids as well as grid expansion and long-distance transmission networks to diversify renewable energy sources (Chum et al., 2014) — the interconnector cable between the UK and Norway, for example.

A key question for financial institutions committed to net zero is whether new assets are required to meet future generation and capacity needs, or if the current stock is sufficient. The IEA NZE does not provide direct data on this. However, natural gas and oil power plant asset lives indicate that 62% of global capacity is less than 20 years old, 33% less than 10, and 17% less than 5 (Figure 5), meaning that a large proportion of the existing asset base will be operational into the 2040s assuming a life of around 30 years. By 2040, in the IEA NZE unabated natural gas capacity falls by 63% in 2040 from 2020 (Figure 6). Therefore, at a global level, the existing stock of assets appears adequate to meet the majority, but not all, of 2040 capacity needs. Even in advanced

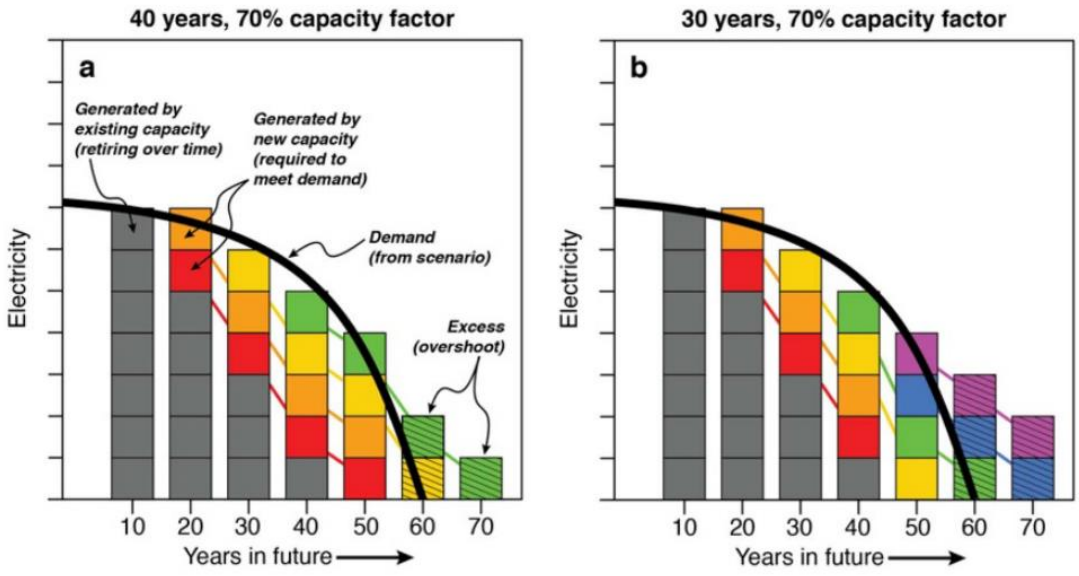
economies such as the G7, where unabated gas-fired power generation falls to 2% of the energy mix by 2035 in the IEA NZE, new assets to replace retired assets are not ruled out. While generation falls by 93% in 2035 compared to 2020, capacity falls by just 62% in the G7, with investment in unabated fossil fuel generation capacity continuing in 2030 and 2040, albeit at significantly reduced levels (IEA, 2021a).

Figure 5: Gas-fired power stations by age



Based on data of Global Gas Plant Tracker, Global Energy Monitor, October 01, 2021.

Figure 6: Early Retirement in a Scenario with Falling Demand



Source: Fofrich et al.(2020). Shows a hypothetical scenario.

The challenge is that any new capacity may need to be retired early or “stranded”, although this depends on the operational life assumed, with model assumptions ranging from 25 to 45 years for new gas power (Fofrich et al., 2020). This is represented in Figure 6 by a hypothetical scenario taken from the same source. Prior studies have shown that all new fossil fuel power infrastructure is incompatible with a 1.5C scenario. For example, Tong et al. (2019) model committed emissions from the electricity sector and find that absent negative emission technologies and CCUS, there can be no new fossil fuel power, and that existing assets will have to reduce lifetimes from 40 to 25 years or reduce capacity factors to below 30% to remain compatible with a 1.5C scenario. Pfeiffer et al.(2016) show that with asset lives of 40 years, the stock of fossil fuel generation assets compatible with a 2C scenario has already been reached, requiring new generation to be zero carbon, retrofitted with CCUS or retired early. In further analysis, Pfeiffer et al. (2018) find that in a 1.5-2C scenario, 20% of existing global capacity will need to be stranded, even if planned projects are stopped. Fofrich et al. (2020) find that in 1.5-2C scenarios, existing fossil fuel power plants are retired before their historical operational lifetimes, and as a result, stress the incompatibility of continued investments in fossil fuel power. Meanwhile, the risks of early asset stranding have already materialized, especially in Europe (Caldecott et al., 2017).

From the perspective of financial institutions, if new natural gas power assets are financed, their ability to avoid premature stranding in a 1.5C scenario will in part depend on the ability to be retrofitted with CCUS or co-fired with low-carbon fuels such as hydrogen. However, there is uncertainty about commercial viability, with significant levels of further research and development required in CCUS (Norhasyima & Mahlia, 2018; Tapia, Lee, Ooi, Foo, & Tan, 2018). CCUS technologies have historically lagged behind expected technological progress (De Coninck & Benson, 2014), with high technology costs posing a challenge to deployment (Wilberforce, Baroutaji, Soudan, Al-Alami, & Olabi, 2019). If negative emissions technologies play no role in pathways compatible with 2C scenarios, more stringent policies are needed to mitigate emissions (Larkin, Kuriakose, Sharmina, & Anderson, 2018) and fewer fossil fuel reserves can be consumed (Budinis, Krevor, Dowell, Brandon, & Hawkes, 2018).

This is not to say that CCUS technologies do not have a crucial role, but their future potential cannot justify the rapid expansion of fossil fuel power. Retiring plants early and decommissioning trillions in private capital comes with significant political, economic, and social issues that can result in inertia within the energy system (Busch & Gimon, 2014; Fofrich et al., 2020). Reducing the amount of new fossil fuel power assets constructed reduces these barriers. Similarly, continued deployment can add to path dependence that drives carbon lock-in (Unruh, 2000), with only an eighth of electric utilities companies prioritising renewables over fossil fuels since 2000 (Alova, 2020). There also needs to be a focus on allocating resources to solar, wind, batteries, and

hydrogen, as maintaining deployment growth rates will drive down costs and accelerate the speed of the low-carbon transition (Way et al., 2021).

Summary

The IEA NZE is unambiguous about the need to rapidly reduce unabated gas-fired power generation from 2030 onwards, with generation falling to below 2% of the energy mix by 2035 in advanced economics. However, as residual capacity is maintained through to 2050, this section does not conclude that no further capacity additions occur. When additions do occur, new capacity will be generally focused on providing grid flexibility and reserve power, with utilisation rates significantly lower and ongoing viability dependent on retrofitting with CCUS or hydrogen, technologies where there is uncertainty regarding future commercial viability. As a result, stranded assets risks are significant.

3. Fossil Fuel Financing Policy

In this section, the implications of IEA NZE conclusions are explored for financial institutions committed to net zero. This is done for fossil fuel production and power generation, first for project finance and then corporate finance.

3.1 Project Finance

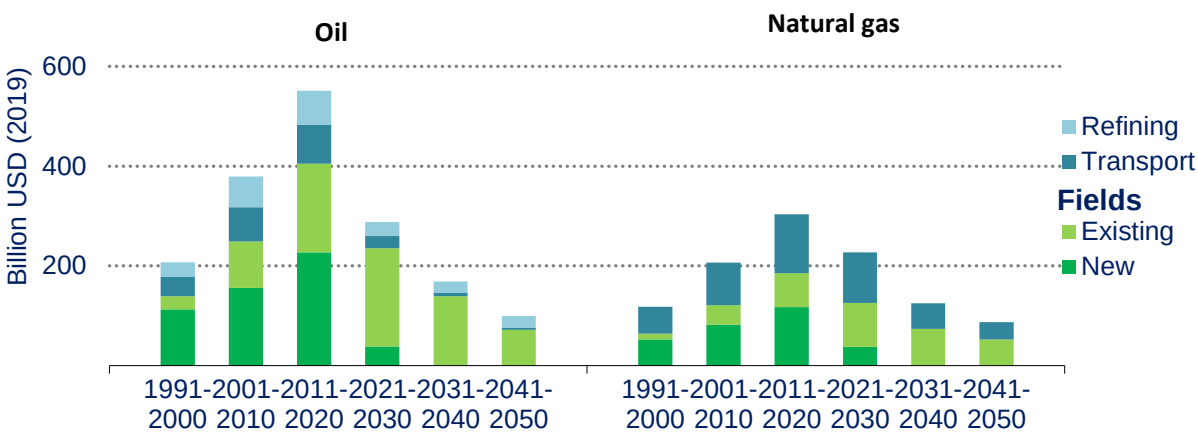
Corporate finance relates to the balance sheet of the borrowing entity, while in project finance, a separate special purpose vehicle (SPV) is used by the project sponsor to obtain financing (Krupa & Harvey, 2017). For renewable energy finance, although the share of project finance has grown over the past decade, corporate finance still accounts for the majority of asset finance (FS-UNEP, 2018). For fossil fuel energy, corporate finance plays an even larger role, as the scale and diversification of incumbent energy companies enable them to obtain a low cost of capital (Duff & Phelps, 2018).

Although corporate finance from company balance sheets provides the majority of financing for new energy infrastructure, project finance also plays a critical role (Ameli et al., 2021; Duff & Phelps, 2018). Unlike corporate finance, project finance lending has no recourse to the project sponsors' assets beyond the project's assets, with the assets in question also delivering the cash flows needed to pay back the loan (Dentons, 2013). Project finance, therefore, reduces contamination risk between the project and project sponsor, reducing bankruptcy risk for the sponsor, especially for large or high-risk projects (Steffen, 2018). Off-balance sheet project finance, via an SPV, also enables highly indebted companies to continue to develop new projects, or for companies with an historically high-risk asset base to obtain a lower cost of capital (Helms, Salm, & Wüstenhagen, 2015; Steffen, 2018).

Given the financing structure of project finance, with loan repayment provided by cash generated by a specific asset, lenders face significant stranded asset risks if fossil fuel power assets are phased out before the maturity of loans provided. In such a situation, creditors could take control of the asset, but if early retirement occurs, it is unlikely that there would be demand as value is derived from the ability to generate future cash flows (Dentons, 2013).

Fossil Fuel Production

Figure 7: Investment in oil and natural gas supply in the NZE



The IEA NZE is clear that the development of new fossil fuel reserves is not required in the scenario modelled given the fall in fossil fuel demand. As shown in Figure 7, investment in new fields is rapidly phased out this decade, with the only investment remaining relating to those already approved for development as of 2021. This results in a 30% fall in capital flows to upstream oil & gas during the 2030s compared to 2015-2020, to around $350bn per year.

The conclusions of the IEA NZE pathway regarding the exploration and development of new fossil fuel reserves make clear the need for financial institutions committed to net zero to end project finance for this purpose. A recent report by ShareAction found that while all of the largest 25 European banks have restrictions on financing for unconventional oil & gas, only two restrict project finance for the exploration of new oil & gas reserves (ShareAction, 2021). Since this report, La Banque Postale in France also committed to ending project finance for oil & gas projects (Reclaim Finance, 2021a).

Fossil Fuel Power Generation

As detailed in Section 2.3.1, the IEA NZE shows that additional coal-fired power generation is not compatible with the scenario modelled for reaching net zero by 2050. Already, restrictions on coal power financing have been incorporated into the financing policies of many financial institutions, especially banks. In 2021, all 25 of the largest European banks restricted project finance for coal power generation (ShareAction, 2021). However, elsewhere, financing by Chinese banks has continued, for example by Chinese banks (Gallagher, Bhandary, Narassimhan, & Nguyen, 2021).

Since 2016, Eikon identifies 33 project finance transactions for coal power. In Figure 10, the maturities of these loans are shown, split into OECD and Rest of World (RoW) showing that 70%

of transactions mature after 2030, of which 26% are in OECD countries. Assuming new coal power plants linked to these transactions have operational lives of 40 years, they are due to operate well beyond IEA NZE phase out dates of 2030 in advanced economics and 2040 elsewhere.

A challenge is that around 90% of coal power plants operate in a form of regulated market, where long-term contracts up to 30 years in length or state ownership insulate plants from cost pressures (Bodnar et al., 2020). This results in inertia within energy systems, whereby even if coal power plants are economically uncompetitive relative to renewables, actors are incentivised to maintain operations. The need to repay project finance creditors over time horizons beyond phase out dates adds to this inertia.

Figure 8: Coal Project Finance Loans (2016-2021)

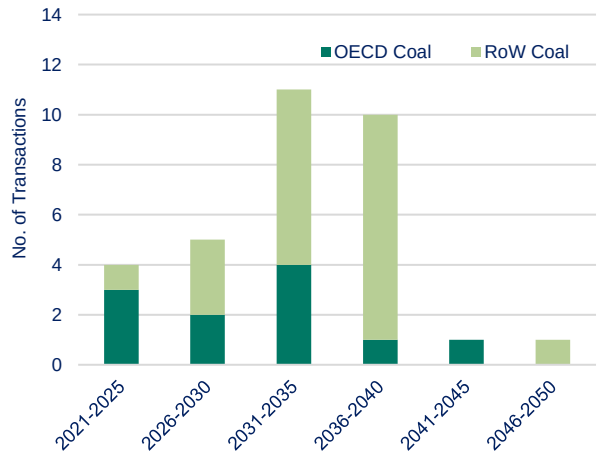
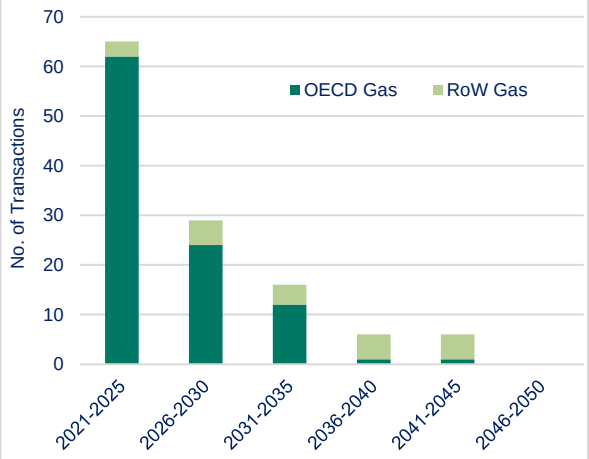


Figure 9: Gas Project Finance Loans (2016-2021)



Unlike coal-fired power generation, the IEA NZE does not rule out further investment in unabated gas power within the scenario modelled, with the compatibility of these assets with a 1.5C scenario context-dependent — depending, for example, on whether construction facilitates a higher penetration of renewables by providing grid flexibility where alternatives are not feasible (IEA, 2021d). Furthermore, while unabated gas capacity increases by 7% globally between 2020 and 2030, it increases by a third in developing economies and falls by 19% in the G7. Data compiled by Global Data shows a planned increase in global gas capacity of 560GW, equivalent to a 24% increase (Ferris, 2021). This indicates that at a global level, a proportion of this planned capacity is not compatible with the pathway in the IEA NZE.

Major private financial institutions are yet to exclude financing for unabated natural gas. However, the European Investment Bank (EIB) has fully restricted lending for unabated natural gas power stations as of 2022, when the development bank's de facto blanket ban on all fossil fuel financing

kicks in (E3G, 2022). The Biden administration's latest orders from December 2021 to halt overseas public financing in fossil fuel power projects are also noteworthy, affecting institutions such as the U.S. International Development Finance Corporation (DFC) and the U.S. Export-Import Bank (EXIM), but with an exception in cases of national security (Volcovici, 2021).

A policy that mirrors coal power financing restrictions through a blanket ban of project financing for gas power expansion may not be appropriate if using IEA NZE as a reference point. But given the need to rapidly reduce natural gas power from 2030, project finance for new assets needs to be sharply curtailed going forward, especially in advanced economies where unabated generation falls below 2% of the energy mix by 2035. Regional specific drivers also need to be considered, such as the availability of alternatives to natural gas to provide baseload power and grid flexibility.

Analysing 122 project finance transactions for gas power from Eikon indicates that transactions are dominated by OECD borrowers, accounting for 92% (Figure 11). Loans also have short maturities, with those maturing after 2030 accounting for only 23% of transactions and 22% of the total amount lent.

3.2. Corporate Finance

Developing a corporate financing policy consistent with the IEA NZE or equivalent scenario is less clear cut, as financing is not tied to a single project but the overall balance sheet of a company and energy companies may engage in both low- and high-carbon projects. This section considers the appropriateness of different types of corporate financing policies to be consistent with the conclusions of the IEA NZE, focusing first on fossil fuel production and then fossil fuel power generation.

3.2.1. Complete Restrictions

Fossil Fuel Production

For fossil fuel production, the IEA NZE is clear that the development of new fossil fuel reserves is not required in the scenario modelled to reach net zero by 2050. Therefore, the most straightforward financing policy is to rapidly phase out and end corporate financing and underwriting for companies involved in the expansion of fossil fuel reserves. Of the 25 largest banks within Europe, one has committed to end corporate financing based on the development of new fossil fuel reserves, with Crédit Mutuel Alliance Fédérale stating that it "will refrain... from providing banking and financial services to groups… which undertake explorations of new oil fields (conventional or unconventional) and new unconventional gas fields" (Crédit Mutuel, 2021; ShareAction, 2021).

Fossil Fuel Power Generation

For fossil fuel power generation, the IEA NZE is clear that no further coal power assets are required in the scenario modelled to reach net zero by 2050. Several leading banks have begun to restrict corporate finance to companies developing new coal power assets, with nine of the largest 25 European banks implementing such a policy (ShareAction, 2021). Credit Agricole, for example, will not finance new clients expanding coal power since 2020 nor existing clients developing new coal power capacity (Crédit Agricole, 2020). Furthermore, this policy encompasses the acquisition of assets from a third party, closing an important loophole.

Although financing for new unabated gas-fired power needs to be sharply curtailed, the IEA NZE is not explicit that all capacity additions need to end. Therefore, this section does not state the need for a complete restriction on corporate finance at present.

3.2.2. Credible Transition Plans

Fossil Fuel Production

Requiring companies to have a credible transition plan to remain eligible for financing is an option taken by Natwest and Danske Bank, who require oil & gas companies to have these plans in place in 2021 and 2023 respectively (these banks also exclude project finance for oil & gas expansion) (ShareAction, 2021).

In their updated guidance on Metrics, Targets, and Transition Plans, the Task Force on Climate-related Financial Disclosures (TCFD) state that a transition plan needs to contain "sufficient information to enable users to assess its credibility" (TCFD, 2021). This needs to include whether a company is engaged in fossil fuel reserves expansion. The Institutional Investors Group on Climate Change (IIGCC), for example, call on oil & gas companies to "disclose total CAPEX in oil and gas exploration activities in the last financial year and a forward-looking budget (minimum three years ahead)" and that exploration CAPEX can be further split into greenfield and brownfield sites (IIGCC, 2021). For context, in 2019, less than one per cent (0.8%) of capital expenditure by oil & gas majors was directed towards low-carbon activities (IEA, 2019).

Defining a credible transition plan is complex, but ending fossil fuel reserves expansion in line with the IEA NZE or equivalent scenarios ought to be a prerequisite for a transition plan to be credible. Including M&A within this is important to avoid a loophole whereby new reserves are developed by another company and then bought.

Many quantitative emission targets for oil & gas companies that feature in climate-related disclosures focus on relative rather than absolute emissions. These carbon-intensity metrics allow for progress towards emission targets while also growing or maintaining fossil fuel production, for example, by reducing upstream flaring and methane slippage, or by investing in renewables. An end to fossil fuel reserve expansion is key to the credibility of these targets, as this will result in a gradual wind-down of absolute production and therefore emissions.

Finally, there is a range of strategies that can be pursued by oil & gas companies to transition, including diversification, working with supply chains to decarbonise, and investing in low-carbon technologies (Caldecott et al., 2018; IIGCC, 2021). These strategies are important but need to be accompanied by a rapid phase out of exploration and production.

Fossil Fuel Power Generation

Banks such as Natwest also require companies engaged in electric utilities with coal exposure to have a credible transition plan to remain eligible for financing if exposure to thermal coal is greater than 15%. For transition plans to be credible, an end to coal power expansion and a phase out of generation in line with the IEA NZE or equivalent scenarios needs to be a pre-requisite. Additional aspects of a credible transition plan include, but are not limited to, policies that ensure the closure of assets as coal power is phased out, rather than the sale of assets to a third party that continues operations (Reclaim Finance, 2021b).

To our knowledge, no financial institutions require credible transition plans from companies engaged in natural gas power generation. However, if financial institutions adopt such an approach, a credible transition plan using the IEA NZE as a reference point would document how unabated generation will be phased out in the 2040s, with absolute reductions in generation

In the UK net zero transition plans will be required for all large companies, asset managers, and asset owners (and investment products) on a comply or explain basis initially, with this being introduced via new Sustainability Disclosure Requirements from 2023. This is world-leading and will almost certainly be adopted by other jurisdictions.

The UK Government is establishing a new high-level Transition Plan Taskforce (TPT) announced at COP26 (HM Treasury, 2021). The TPT will start in Q1 2022 with a two-year mandate and is being tasked with, among other things, making recommendations on what good transition plans look like and the metrics that could be used to track progress towards delivery. The Taskforce will cover real economy sectors, as well as different finance sub-sectors. There will be strong connectivity with international processes and initiatives, including the newly launched ISSB and GFANZ.

starting in the 2030s. Regarding any planned expansion, companies should detail how expected operating lives are compatible with these phase out dates.

3.2.4. Thresholds

Fossil Fuel Production

At present, thresholds are used by financial institutions to identify energy companies eligible for financing. These thresholds can be financial (e.g. % of revenue) or activity-based (e.g. % of oil production or electricity generated). For example, Credit Agricole requires companies to generate less than 25% of turnover from thermal coal and to provide a phase out plan in line with the Paris Agreement to be eligible for corporate financing (Crédit Agricole, 2020). For oil & gas, corporate finance thresholds are used by banks when providing financing to companies involved in unconventional oil & gas (e.g. arctic oil & gas and tar sands).

Within the context of reserve expansion, thresholds could be applied to oil & gas companies based on the proportion of revenue or CAPEX attributable to upstream exploration related activities. Given that certain banks are likely to resist an immediate end to financing for this purpose, this provides a mechanism to reduce financing over time as thresholds fall. Resistance from banks can be attributable to the significant investment banking fees generated relative to sectors such as coal mining, where banks are more willing to restrict financing. However, the IEA NZE does not see fossil fuel reserve expansion gradually phased out within the scenario modelled but is ended immediately (apart from those already approved in 2021).

In contrast to banks, asset owners do not have commercial relationships with investee fossil fuel companies, and so are more willing to restrict financing, with many pension funds implementing full divestment policies covering oil & gas as well as coal (350.org, 2021). Asset managers committed to net zero by 2050 need to follow suit and ensure that capital is not provided to companies engaged in new fossil fuel reserve expansion. Yet many asset managers, especially those engaged in passive investment, state that this is not possible given the inclusion of upstream oil & gas companies in mainstream indices (Jahnke, 2019). However, as argued by Wilson & Caldecott (2021), even passive managers are able to stop the financing of fossil fuels through primary markets, while De Jong & Nguyen (2016) have shown a reduction in portfolio carbon-intensity through the exclusion of fossil fuels has limited impact on tracking error.

Fossil Fuel Power Generation

As highlighted above, thresholds are already often used when financing power generation companies with exposure to coal-based power generation. This approach can incentivise companies to reduce their exposure to coal-based power generation and manage the exposure of

financial institutions to stranded asset risk. However, a drawback of only using thresholds is that companies can reduce their relative exposure through investments in other power sources, such as natural gas, while keeping coal-fired power generation constant or even increasing. Therefore, threshold-based lending policies need to be combined with a requirement for companies to end the expansion of coal-based power generation and reduce absolute generation and capacity overtime.

For gas-based power generation, thresholds can also be used to manage stranded asset risk and incentivise companies to transition. However, in the IEA NZE, absolute reductions in generation and capacity do not begin globally until after 2030, after which point the share of generation falls sharply. Therefore, implementing a threshold-based policy for natural gas, based on the IEA NZE or alternative scenario, could be challenging at present. An advantage of a threshold-based policy is that it can be adjusted over time as unabated natural gas generation is phased out. Crucially, this doesn't prevent companies from maintaining gas capacity for grid flexibility needs.

3.2.5 Use of Proceeds

The development of financing policies in the energy sector has coincided with the innovation of green financing instruments. This includes green bonds, where the issuer commits to using funds for "green" projects by specifying the use of proceeds. This element is similar to project finance, which provides capital for a specific activity. For example, in Credit Agricole's coal policy, companies that have exposure to coal above 25% are still eligible for financing if capital raised is dedicated to renewable energy or GHG reduction projects (Crédit Agricole, 2020). The advantage of such a policy is that financial institutions can support companies through their transition.

However, if the company is engaged in the expansion of fossil fuel assets, financial institutions have to consider whether use of proceeds corporate financing, even for green projects, is wise. Financing of this nature frees up capacity for companies to fund fossil fuel expansion through their own balance sheet, or via other financial institutions not concerned with supporting this activity. Green loans or bonds issued by these companies could also be "greenwashing". Finally, as use of proceeds financing is tied to the risk of the overall balance sheet, financial institutions will be exposed to the climate risk of these activities. Therefore, when providing use of proceeds finance, financial institutions need to ensure that the transition plans of companies financed are credible, which in the context of oil & gas, requires an end to fossil fuel reserve expansion, and in electric utilities, an end to the development of coal assets and a phase out of fossil fuel generation.

For example, before COP26, the president of the European Investment Bank (EIB) stated that the bank will stop lending from 2021 onwards to companies that partake in activities incompatible with the Paris Agreement, including increasing production from existing oil & gas assets and investing

in new unconventional oil & gas production (not all oil & gas expansion) (European Investment Bank, 2021). Included in this policy is an end to financing for low-carbon projects by companies deemed incompatible, although exceptions can be made for important demonstration projects that can drive down costs in emerging technologies. Similarly, the EIB will not fund a low-carbon subsidiary if the activities of the parent company are incompatible (European Investment Bank, 2021). However, ring-fenced SPVs with more than one shareholder are out of scope (European Investment Bank, 2021).

3.2.6 Sustainability-linked Finance

An interest in transition finance, in order to support the decarbonisation of high-carbon sectors, has grown in prevalence in recent years (Caldecott, 2020b). An example of innovation in this area is sustainability-linked finance. In contrast to use-of-proceeds instruments, sustainability-linked financial products do not require that the proceeds be employed for a green purpose (ICMA, 2020). Rather than that, its conditions incentivise the issuer to enhance its sustainability performance against predefined sustainability performance targets (SPT) based on key performance indicators (KPIs). Particularly, the key element is a sustainability linked pricing ratchet, which means that if the issuer meets the SPTs, the margin on the security is adjusted accordingly. Sustainability-linked pricing ratchets can be one-way or two-way (Linklaters, 2021). The one-way structure means that if the issuer meets the SPTs, the margin is decreased. The profit margin remains unchanged if the sustainability targets are not met. The alternative two-way strategy reduces the margin when SPTs are satisfied but provides a margin premium when they are not.

Five years after the first sustainability-linked loan was issued, the market for sustainability-linked loans has surpassed USD 440 billion in 2021 (Environmental Finance, 2021). Issuance in specific energy industries reached USD 90 billion at the end of 2021, accounting for about 20% of the market's total size since inception. However, in the electric utilities sector, only 10% link metrics to reductions in scope 3 emissions (Environmental Finance, 2021). Similarly, landmark issuances in the fossil fuel production sector, such as Eni S.p.A issuance of the world’s first sustainability-linked bond, did not include scope 3 emissions (Crédit Agricole, 2021). Therefore, while sustainability-linked finance has an important role to play in supporting companies to transition, as a form of corporate finance, financial institutions need to ensure that the overall transition plan of the company is credible.

3.3 Summary

Section 3 of this briefing evaluated different options for financing policies in the energy sector, focusing on fossil fuel expansion within the IEA NZE. The conclusions are summarised below.

Fossil Fuel Production

1. End project finance for fossil fuel expansion activities related to the development of new reserves not approved for development as of 2021.
2. To be eligible for corporate finance and underwriting, require companies to implement transition plans ending the expansion of new fossil fuel reserves if not approved for development as of 2021, with production then reduced over time as existing reserves are utilised.
3. Continue to provide ring-fenced project finance for critical low-carbon projects.

Fossil Fuel Generation

1. End project finance for new coal-fired power generation.
2. To be eligible for corporate finance and underwriting, require companies to implement transition plans ending the expansion of coal-fired power generation, with existing generation phased out by 2030 in advanced economies and 2040 in the rest of the world.
3. Require companies to detail and implement transition plans to reduce unabated gas generation in line with IEA NZE phase out dates, falling in absolute terms from 2025 and by over 90% by 2040.
4. Continue to provide ring-fenced project finance for critical low-carbon projects.

These high-level policies apply to *financing activities*. For example, an equity holder could purchase shares through the secondary market in companies engaged in the expansion of fossil fuel reserves and then leverage their shareholdings to conduct forceful engagement. In addition, these recommendations are not exhaustive, as they are focused on fossil fuel expansion and do not address other elements of financing policies, such as unconventional fossil fuel production or other environmental issues.

4. Case Studies

In this section, illustrative case studies are provided covering one asset manager, investment bank, and development bank. Barclays and BlackRock are selected because of their size and significant financing of fossil fuels. For development banks, an overview of fossil fuel financing policies is provided for several institutions, but with a focus on the World Bank. The objective of these case studies is to highlight the potential challenges for financial institutions in relation to the conclusions of the IEA NZE, specifically their exposure to fossil fuel expansion and fossil fuel assets with long operational lives. This is achieved by taking financial transactions and evaluating the underlying activities of companies financed.

5.1 Asset Manager

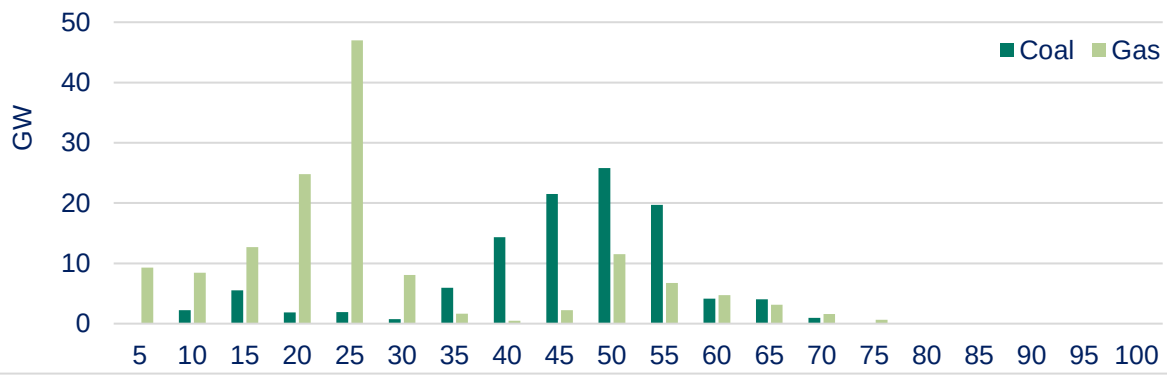
BlackRock is the world's largest asset manager, with over $10 trillion in AUM, and is the world's second largest asset manager in terms of investments in the coal industry (Tom Saunders, 2021). BlackRock's AUM is dominated by passive funds, which account for two-thirds of total assets (Pensions & Investments, 2021) and 88.7% of fossil fuel holdings (Greenfield, 2019). BlackRock has made clear that passive fund structures limit their ability to reduce their exposure to fossil fuels (Jolly, 2019). However, not only do passive funds hold significant fossil fuel assets, but they also make active decisions to channel capital into these sectors via primary market transactions, despite tracking indexes that rebalance monthly (Wilson & Caldecott, 2021).

Fossil Fuel Power Generation

Unlike mutual funds that report holdings monthly or quarterly, daily holdings are disclosed for ETFs, allowing for primary market trades to be tracked. Using the same method as C. Wilson & Caldecott (2021) this is done from Jan 2016 to Dec 2021 for BlackRock's two largest investment grade and high yield corporate bond ETFs: iShares iBoxx $ Investment Grade Corporate Bond ETF (LQD) with an AUM of $37 billion and iShares iBoxx $ High Yield Corporate Bond ETF (HYG) with an AUM of $20 billion. This results in 38 companies being financed in the electric utilities sector that are then matched to the S&P World Electric Power Plant (WEPP) database from September 2021, with 84% of companies successfully matched to WEPP. Using WEPP, the current and planned asset mix of these companies is aggregated and shown in Table 2. As the asset mix is not weighted by transaction value, this is not a representation of the financing energy mix, but rather a representation of the combined asset base.

Table 2	Operational			Planned and Under Construction		
Fuel	Capacity (MW)	Energy Mix	Age (Weighted)	Capacity (MW)	Energy Mix	Expansion
Gas	143,024	32.0%	25.0	9,962	22.20%	6.97%
Coal	108,847	24.3%	42.2	-	-	-
Nuclear	63,691	14.2%	41.4	2,234	4.98%	3.51%
Waste	42,901	9.6%	16.3	1,941	4.33%	4.52%
Wind	37,816	8.5%	9.2	13,723	30.58%	36.29%
Hydro	21,415	4.8%	56.3	668	1.49%	3.12%
Oil	15,521	3.5%	42.2	31.6	0.07%	0.20%
Solar	12,349	2.8%	4.8	16,190	36.08%	131.10%
Geothermal	1,395	0.3%	41.7	128	0.29%	9.18%
Bioenergy	272	0.1%	23.3	-	-	-
Other	63	0.0%	25.8	-	-	-

Figure 10: Capacity by Age



As LQD and HYD only include dollar denominated debt, there is a strong US focus in the underlying asset base. As a result, it is unsurprising that while coal accounts for 24.3% of the energy mix, no further coal power is planned. However, within the planned and under construction capacity, gas accounts for 22.2%, with wind and solar accounting for 30.6% and 36.1% respectively. For gas, this expansion represents an increase in capacity of 7%. This divergence between coal and gas power is reflected in Figure 10, with gas power stations much younger in age than coal plants. The age distributions show that for gas power, 38.6% of capacity is below 20 years in age, compared to 8.9% for coal. Over 10 years, these figures are 12.4% for gas and 2.1% for coal.

This highlights the need for asset managers to ensure that companies financed have a clear phase out plan for fossil fuel power generation, as a proportion of expected asset lives extend beyond IEA NZE phase out dates. Furthermore, this clearly shows that passive funds, despite tracking indexes that rebalance monthly, are directly channelling capital through primary markets into companies expanding in fossil fuel power.

Fossil Fuel Production

Using the same approach as for fossil fuel power, a total of 88 companies are identified in the oil & gas sector that are then matched to Urgewald's "Global Oil & Gas Exit List" (GOGEL), with 42% of companies successfully matched. This database provides information on short-term oil & gas expansion activities, capturing companies accounting for over 90% of global hydrocarbon production and over 90% of planned short-term upstream expansion and over 90% of exploration CAPEX. Short-term expansion activities are defined as the Estimated Ultimate Recovery (EUR) of Assets Under Field Evaluation[1] and Assets Under Development[2], the two life cycle stages of an asset before production. In Table 3, expansion activities are expressed as a percentage of year-end 2020 hydrogen carbon reserves, which is obtained from Bloomberg. GOGEL also provide an estimate of CAPEX linked to exploration activities, averaged over 2019-2021, with full-year 2021 figures taken from company forecasts. In Table 3, this is expressed as a percentage of total CAPEX averaged over the same period, with data obtained from Bloomberg.

Table 3 shows that for the companies financed by these ETFs, short-term expansion represents 44% of total 2020 reserves. The proportion of this exploration linked CAPEX to overall CAPEX averages 11%. These figures demonstrate the clear disconnect between the conclusions of the IEA NZE and the current activities of oil & gas companies. It also makes clear the need for credible transition plans to address this activity.

Table 3

	Short-term Reserve Expansion (2021) (mmboe)	Reserves 2020 (mmboe)	Growth in Reserves	Exploration CAPEX/ Total CAPEX (2019-2021)
All Companies (Aggregate)	19279	44205	44%	11%
All Companies (Average)	742	1700	49%	8%
Top 10 by Expansion				
Equinor ASA	2677	5260	51%	13%
EQT Corporation	2387	3300	72%	2%
EOG Resources Inc	1921	3220	60%	7%
ConocoPhillips	1907	4459	43%	14%
Hess Corporation	1258	1170	108%	18%
Ovintiv Inc	1170	1992	59%	3%
Antero Resources	1065	2940	36%	7%
Cenovus Energy Inc	951	5030	19%	2%
Devon Energy Corporation	724	752	96%	13%
Coterra Energy Inc	641	2279	28%	4%

[1] Defined in GOGEL as "assets in which a company has already made considerable investments: A plan for development and operation (PDO) has been finalized and Front End Engineering and Design (FEED) has been confirmed".

[2] Defined in GOGEL as "oil & gas assets which will soon enter the production phase: All necessary permits are in place and a Final Investment Decision (FID) has been made".

5.2 Investment Bank

To illustrate the challenges raised by the IEA NZE for an investment bank, we analyse the activity of Barclays in the electric utilities sector. Barclays is chosen for several reasons. First, Barclays has committed to be a net zero bank by 2050 and is part of the Net Zero Banking Alliance. Second, Barclays is in the top 10 fossil fuel financiers globally and the largest in Europe (BankTrack, 2021).

Fossil Fuel Power

Taking Barclays' syndicated loan transactions, as well as bond and equity underwriting activity since 2016 from Eikon, 256 companies (including joint ventures) are identified, of which 62% are successfully matched to the WEPP database. Capacity is aggregated to provide an illustrative energy mix for the operational footprint of these companies. As capacity is not weighted by the amount financed, this is not intended to be a representation of the energy mix of financing. Furthermore, as this includes equity and debt underwriting, Barclays is likely to not have direct credit exposure to many of these companies.

Table 4	Operational			Planned and Under Construction		
Fuel	Capacity (MW)	Energy Mix	Age (Weighted)	Capacity (MW)	Energy Mix	Expansion
Gas	339,784	23.80%	23.6	43,987	16.64%	12.9%
Coal	325,981	22.80%	33.2	17,869	6.76%	5.5%
Nuclear	202,350	14.10%	37.5	16,604	6.28%	8.2%
Hydro	199,581	14.00%	46.3	19,153	7.25%	9.6%
Wind	155,391	10.90%	8.7	106,060	40.13%	68.3%
Waste	94,407	6.60%	16.6	7,478	2.83%	7.9%
Oil	61,324	4.30%	38.8	809	0.31%	1.3%
Solar	37,765	2.60%	4.9	50,457	19.09%	133.6%
Bioenergy	7,576	0.50%	14.2	582	0.22%	7.7%
Geothermal	3,658	0.30%	30.5	1,269	0.48%	34.7%
Other	2,346	0.20%	29.6	-	-	-

Figure 12: Capacity by Age

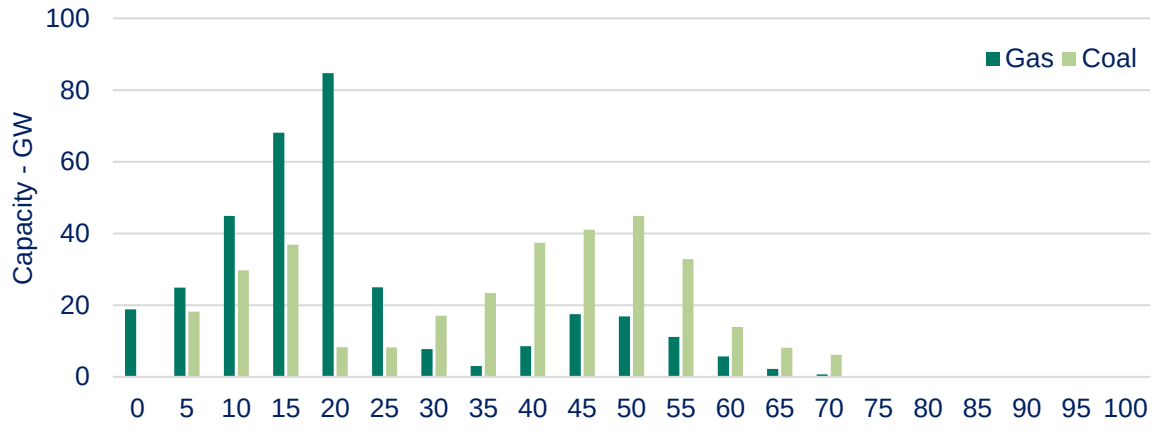


Table 4 combines the energy mix of the companies Barclays has financed, using the method described above. Gas accounts for the largest proportion of the energy mix of these companies, followed by coal. In terms of asset age, coal and gas power have a capacity weighted average asset lives of 33 and 24 years respectively. Examining the distribution of asset lives in more detail in Figure 8, we can see that 29% and 46% of coal and gas power plant capacity is below 20 years in age, while 15% and 12% of capacity are under 10. Given IEA NZE phase out dates in the 2030s for coal and 2040s for gas, a proportion of assets may need to be retired early. This demonstrates the need for companies financed to have a clear plan to phase out existing fossil fuel generation.

With regard to fossil fuel expansion, Table 5 shows a planned or under construction increase in capacity of 11% for natural gas power and 5.5% for coal power. Those companies expanding coal power are shown below in Table 3. Barclays financed these companies between 2016-2018. Their current coal policy, which excludes companies deriving over 50% of revenue from coal, would exclude these companies according to the Global Coal Exit List developed by Urgewald.

Table 5

Company	Coal Energy Mix	Operational	Under Construction	Planned	Region	Bond Finance
NTPC	84%	54,299	10,190	2,120	India/ Bangladesh	2016,2017,2018
Adani Power Ltd	100%	12,410	1,600		India	2017
Korea Midland Power	50%	6,000	1,009	550	South Korea	2016
Eskom	84%	42,560	2,400		South Africa	2018

Fossil Fuel Production

From Eikon, a total of 311 companies are identified in the oil & gas sector financed by Barclays since 2015. These are then matched to the GOGEL database, with 23% of companies successfully matched. Out of these 72 companies, Bloomberg provided sufficient data for only 40. In Table 6, expansion activities of these remaining firms are shown as a percentage of 2020 hydrogen carbon reserves, and CAPEX linked to exploration activities is shown as a proportion of total CAPEX. The same method as described for BlackRock is followed. Table 6 shows that for the oil & gas companies financed by Barclays, short-term expansion in reserves, defined as Assets Under Field Evaluation and Assets Under Development, represent 39% of total 2020 reserves, while the proportion of exploration linked CAPEX to overall CAPEX over 2019-2020 is 10%.

Table 6				
	Short-term Reserve Expansion (2021) (mmboe)	Reserves 2020 (mmboe)	Growth in Reserves	Exploration CAPEX/ Total CAPEX (2019-2021)
All Companies (Aggregate)	47415	120660	39%	10%
All Companies (Average)	1185	3016	49%	12%
Top 10 by Expansion				
Exxon Mobil Corporation	7388	15212	49%	9%
TotalEnergies SE	4306	12328	35%	7%
Chevron Corporation	4006	11134	36%	9%
Royal Dutch Shell plc	3779	9100	42%	12%
BP plc	3189	17983	18%	7%
Equinor ASA	2677	5260	51%	13%
EQT Corporation	2387	3300	72%	2%
EOG Resources Inc	1921	3220	60%	7%
ConocoPhillips	1907	4459	43%	14%
Eni SpA	1894	6905	27%	9%

5.3 Development Banks

Development Banks often provide financing to projects when private capital is lacking, for example, due to high levels of risk. This is typical for R&D, energy or urbanisation projects, especially in emerging markets (Pazarbasioglu, 2017). As such, development banks have historically provided financing for fossil fuel expansion and infrastructure to meet energy demand for development (Gallagher et al., 2021).

However, this activity can contradict the stated climate objectives of these institutions. At the Finance in Common Summit in November 2020, 450 development banks jointly declared to align their activities with the objectives of the Paris Agreement and increase the pace of the energy transition (Finance in Common, 2020). Some banks, such as the European Investment Bank, the Inter-American Development Bank, and the World Bank Group had already begun to alter their fossil fuel financing policies, with restrictions implemented between 2018-2019.

Despite these efforts, fossil fuel financing has continued. Since 2020, major development banks have financed more than $3bn of fossil fuel projects (Energy Policy Tracker, 2022). This is driven by a lack of policies to restrict fossil fuel financing beyond coal power, as shown in Table 7 (E3G, 2021). A notable exception is the European Investment Bank (EIB), which restricts all direct and intermediated (through other banks or funds) fossil fuel financing and has committed to be Paris Aligned as of 2021.

Table 7			
Development Bank	**Exclusion**	**Development Bank**	**Exclusion**
Asian Dev. Bank	All coal, upstream and midstream oil, gas exploration and related infrastructure (comprises ALL operations of the bank)	**International Finance Corporation**	All coal, upstream oil & gas and related infrastructure (also limits coal exposure of corporate equity investments)
African Dev. Bank	All coal (informal statement)*, oil & gas exploration*	**Inter-American Dev. Bank**	All coal, upstream oil & gas and related infrastructure (only mentions direct and intermediated project finance)
Asian Infrastructure Inv. Bank	All coal (informal statement, also includes capital markets portfolio)	**Islamic Dev. Bank**	-
China Dev. Bank	Unabated coal power*	**Japan International Cooperation Agency**	Unabated coal power*
European Bank for Reconstruction and Development	All coal, upstream oil & gas and related infrastructure*	**Korean Development Bank**	Unabated coal power*
European Inv. Bank	All fossil fuels and related infrastructure (comprises ALL operations of the bank)	**World Bank**	All coal, upstream oil & gas and related infrastructure (only mentions direct and intermediated project finance)

Source: E3G.
*Unclear whether the policy also restricts financing corporate finance.

Examples of this financing activity include the African Development Bank (AfDB) providing $400mn in loans in 2019 to finance an LNG project in Mozambique, which includes the development of offshore extraction facilities (AfDB, 2022). Even when policies exist, carveouts enable the continued financing of fossil fuel activity. For example, the European Investment Bank financed two gas projects since its 2019 commitment to halt fossil fuel financing. Specifically, 160 and 826 MW gas-fired combined cycle power plants in Cyprus (EIB, 2020) and Greece respectively (EIB, 2019). This was possible because the bank allowed a 3-year transition period until the new financing policy takes full effect (Taylor, 2021).

Another example is the World Bank, which excludes financing for coal (since 2013) and upstream oil & gas (since 2019), unless required to ensure sufficient energy supply in developing countries. For example, the World Bank Group has agreed to provide $200mn to PLN, the Indonesian State Electricity Company, in 2022 (World Bank, 2021). The main goal of this liquidity injection is to support the firm's cash flow to overcome issues caused by the Coronavirus. However, PLN is planning a 20 GW expansion of coal power in Indonesia until 2025 (IEEFA, 2021).

Beyond financing, the World Bank has continued to provide technical assistance for natural gas production and exports in Mozambique that runs until the end of 2022 (Climate Home News, 2020).

Part of this assistance is designing transaction contracts between ENI and ExxonMobil for the $20 billion LNG project in Mozambique, due to begin operation in 2024 (Energies, 2021; Urgewald, 2020). While this activity does not directly provide liquidity to the company, it supports new upstream natural gas production.

In light of these cases, it is encouraging that at COP26, four development banks, including the EIB, and 35 countries signed the *Statement on International Public Support for the Clean Energy Transition* (COP26 UK, 2021). This requires signatories to "end new direct public support for the international unabated fossil fuel energy sector by the end of 2022, except in limited and clearly defined circumstances". Signatories then commit to encourage other countries to follow this policy, and to work to ensure multilateral development banks take the same approach. Even though few development banks signed the document, the signatory countries have significant voting power at multilateral development organisations (The Big Shift, 2021), which increases the likelihood of adoption (Table 8).

Table 8

Development Bank	Voting Power	Development Bank	Voting Power
Asian Dev. Bank	35%	**European Bank for Reconstruction and Development**	67%
African Dev. Bank	38%	**Inter-American Dev. Bank**	51%
Asian Infrastructure Inv. Bank	22%	**World Bank**	45%

Source: Big Shift Global.

5.3 Summary

In this section, transaction-level data was mapped to asset-level power station databases (WEPP) and a database tracking oil & gas expansion activity (GOGEL). This was done for BlackRock and Barclays, two of the largest financial institutions in their respective sectors, both in terms of size and fossil fuel financing. The conclusions of these case studies are summarised below.

- In fossil fuel power generation, the combined asset base of companies financed shows that a significant proportion of capacity is below 20 and 10 years in age, with expected operational lives extending into the 2030s and 2040s, when coal power is phased out and gas generation reduced to only 1% of the energy mix in the IEA NZE. This demonstrates the need for financial institutions to require electric utilities companies to detail and implement transition plans with clear phase out dates for fossil fuel power generation, and to address the compatibility of any gas power expansion.
    - For matched companies financed by BlackRock ETFs selected, 38.6% of gas capacity is below 20 years in age, while 12.4% is below 10. For coal power, these figures are 8.9% and 2.1%.

- For matched companies financed by Barclays 46% of gas capacity is below 20 years in age, while 12% is under 10 years. For coal power, these figures are 29% and 15%.
- For matched companies financed by BlackRock ETFs selected, 22% of planned or under construction capacity is in gas. For matched companies financed by Barclays, this figure is 17%. This is equivalent to a growth in capacity of 7% and 13%.

- In the fossil fuel production sector, there is a stark disconnect between the conclusions of the IEA NZE, with requires a halt to fossil fuel reserve expansion, and the current activities of oil & gas companies. As oil & gas companies develop transition plans and financial institutions require them to remain eligible for financing, an end to fossil fuel expansion must be a prerequisite for credibility.
  - For matched companies financed by BlackRock ETFs selected, short-term expansion plans in 2021 represent an increase of 44% relative to total 2020 reserves, while over 2019-2021, expansion linked CAPEX represents 11% of overall CAPEX.
  - For matched companies financed by Barclays, short-term expansion plans in 2021 represent an increase of 39% relative to total 2020 reserves, while over 2019-2021, expansion linked CAPEX represents 10% of overall CAPEX.
- With regard to development banks, a lack of policies, or loopholes in financing policies, such as those of the World Bank, enable the continued support of activities related to fossil fuel expansion. Development banks need to revisit these financing policies in the light of the conclusions of the IEA NZE.

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