INTERNATIONAL ENERGY AGENCY WORLD ENERGY OUTLOOK 2020:

NET ZERO EMISSIONS BY 2050 SCENARIO

This briefing note, for Climate Action 100+ (CA100+) signatories and IGCC and AIGCC members, provides an overview of the recently released International Energy Agency (IEA) Net Zero Emissions by 2050 (NZE2050) scenario and some preliminary analysis comparing the scenario against other IEA and 1.5°C scenarios. It is intended as a resource for ongoing engagement with energy companies on climate change.

Overall, NZE2050 is a welcome addition to IEA's suite of energy scenarios and provides a decarbonisation pathway that is significantly more ambitious than other IEA scenarios by 2030. However, for companies to be able to use NZE2050 in their climate change reporting, IEA will need to extend the time frame to 2050, ensure they are not overestimating demand for coal and natural gas, and include further detail. In the meantime, investors should encourage companies to consider the demand forecasts in comparison with the most ambitious scenarios they are currently using, and comment on the impact that a further reduction on fossil fuel demand would have on the resilience of their business.

BACKGROUND

The IEA World Energy Outlook[1] (WEO) provides an annually updated view on how the global energy system could develop in coming decades. Due to future uncertainty, multiple scenarios are explored and this year, IEA has for the first time included a pathway that reaches net zero emissions globally by 2050 (NZE2050). According to the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C[2] (SR1.5), this would provide a 50% chance of limiting the global average surface temperature rise to 1.5°C without a large level of negative emissions.

Energy companies are increasingly using scenarios in their climate change reporting to:

- Align their reporting with the recommendations of the Task Force for Climate-related Disclosures[3] (TCFD).
- Demonstrate the resilience of their business models under different plausible futures to stakeholders.
- Understand demand of products under different scenarios and inform long-term capital investment decisions.
- Guide company transition or decarbonisation strategies, including setting emission reduction targets.

IEA scenarios are well-known and well-regarded by energy companies and have good granularity in describing the energy transition. However, IEA has historically underestimated the growth and economics of renewable energy[4,5], and its scenarios to date have been criticised for not being sufficiently ambitious (misaligned with 1.5°C).

OVERVIEW

The IEA WEO 2020 explores global energy demand in three long-term scenarios:

- Stated Policies Scenario (STEPS): incorporates announced policy intentions and targets, where they are backed up by detailed measures for their implementation.
- Sustainable Development Scenario (SDS): outlines transformation of the global energy system to deliver on energy-related Sustainable Development Goals and reach net-zero emissions by 2070, providing a 50% probability of limiting temperature rise to less than 1.65°C.
- NZE2050: extends SDS analysis and includes the first detailed IEA modelling of what is needed in the next ten years to put global carbon dioxide (CO_2) emissions on track to net zero by 2050.

Table 1 provides global energy demand by fuel type for each scenario. Notably, NZE2050 has significantly lower absolute primary energy demand (a function of the efficiency of electric power), lower absolute fossil fuel demand and a higher proportion of renewable energy compared to SDS and STEPS.

	2019	2030		
Fuel types		STEPS	SDS	NZE2050
Coal	3,775	3,503	2,243	1,450
Oil	4,525	4,774	3,963	3,000
Natural Gas	3,340	3,816	3,312	3,000
Nuclear	727	803	895	950*
Hydro	370	438	475	475*
Bioenergy	1,354	1,630	1,283	1,250*
Other renewables	314	792	1,207	1,650*
Total Primary Energy	14,405	15,756	13,378	11,775

Table 1: Global energy demand (Mtoe) for different fuel types in 2030 under IEA scenarios: STEPS, SDS, NZE2050. Asterisks are values that were taken from graphs in IEA WEO 2020. Mtoe is millions of tonnes of oil equivalent.

Chapter 4 of IEA WEO 2020 focuses on the transition required over the next ten years to align with NZE2050 and reduce global CO2 emissions to 20.1 Gt/year by 2030, including the following steps:

- Primary energy demand falls by 17%.
- Coal demand falls by 60%, and virtually no subcritical and supercritical coal plants without carbon capture and storage (CCS) remain.
- Oil demand falls by 34% and natural gas demand falls by 10%.
- Renewables (not including hydro and bioenergy) demand increases by 425% and worldwide annual solar photovoltaic (PV) additions expand from 110GW to 500GW.
- Power sector investment annually nearly triples from $760 billion to $2,200 billion, with more than one-third spent to expand, modernise and digitalise electricity networks and half spent in renewables.
- Global sales of passenger cars comprise 50% of total sales (50 million cars), a doubling of battery manufacturing capacity growth and ramp up of hydrogen production and distribution.

COMPARING NZE2050 TO IPCC, SBTI AND NGFS SCENARIOS

While NZE2050 is clearly more ambitious than SDS, it is important to understand whether it is ambitious enough and whether it overestimates reliance on fossil fuels and CCS. Hence, we examine NZE2050 against three other widely adopted scenario groups.

NZE 2050 vs IPCC scenarios. The IEA WEO 2020 has compared NZE2050 to the 90 scenarios included in IPCC SR1.5. These scenarios use a wide range of macroeconomic assumptions and include both low and high overshoot scenarios. Scenarios have low overshoot if temperatures temporarily exceed 1.5 °C by less than 0.1°C before returning to less than 1.5°C in 2100, and those with high overshoot temporarily exceed 1.5°C by 0.1-0.4°C before returning to less than 1.5 °C in 2100. In 2030, NZE2050 has higher:

- Primary energy demand than around two-thirds of IPCC 1.5°C scenarios.
- Coal demand than around 70% of IPCC 1.5°C scenarios.
- Oil demand than around 25% of IPCC 1.5°C scenarios.
- Natural gas demand than around 50% of IPCC 1.5°C scenarios.
- CCS use than around 50% of the IPCC 1.5°C scenarios.

Figure 1 shows the minimum, average and maximum coal, oil and natural gas demand of the IPCC scenarios, in comparison to NZE2050 in 2030. As suggested by the statistics above, coal and natural gas demand is similar to the average of the IPCC scenarios, while oil demand is approximately 1000 Mtoe less in NZE2050 compared to the IPCC average. While these results suggest that NZE2050 may not be overestimating fossil fuel demand compared to the IPCC scenarios, some of the scenarios are not viewed as plausible (e.g. where peak emissions occurred pre-2020) or responsible (e.g. higher temperature overshoot). To address this, the Science Based Targets Initiative (SBTi) has defined a set of criteria in the Foundations of Science-based Target Setting[6] report, which identifies a subset of 20 plausible and responsible IPCC 1.5°C scenarios.

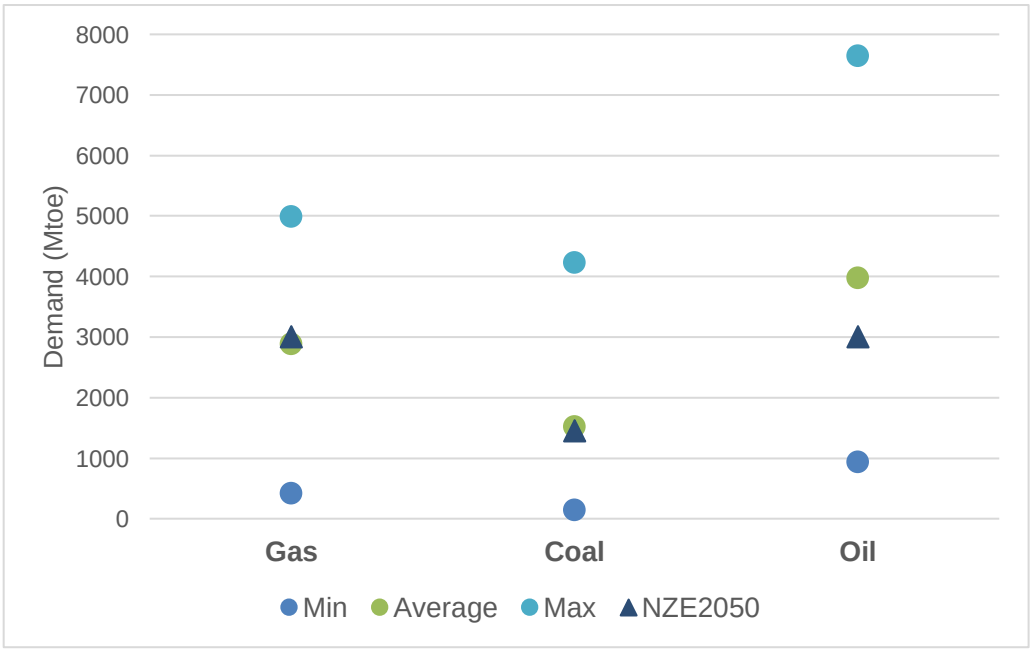

Figure 1: Minimum (min), average and maximum (max) natural gas, coal and oil demand in 2030 (Mtoe) for the 90 IPCC 1.5°C scenarios in SR1.5, compared to NZE2050.

NZE2050 vs SBTi. SBTi requires 1.5°C scenarios to have low temperature overshoot, peak emissions occurring post-2020, a bioenergy limit of 135 EJ/year by 2050 (which limits unrealistic use of CCS), and annual linear reduction that is more ambitious than the lowest 20th percentile of the scenario set between 2020 and 2035. As IEA WEO 2020 only provides information to 2030, it is not possible to assess NZE2050 against these criteria, however it is possible to compare to the SBTi-approved subsection of IPCC 1.5°C scenarios (Appendix 1, Foundations of Science-based Target Setting[6]). In 2030, NZE2050 has higher:

- Primary energy demand than 95% of SBTi approved 1.5°C scenarios.
- Coal demand than 100% of SBTi approved 1.5°C scenarios.
- Natural gas demand than 90% of SBTi approved 1.5°C scenarios.
- Oil demand than 40% of SBTi approved 1.5°C scenarios.
- CCS use than 45% of SBTi approved 1.5°C scenarios.

Figure 2 shows the minimum, average and maximum coal, oil and natural gas demand of the SBTi approved IPCC scenarios, in comparison to NZE2050 in 2030. While NZE2050's oil demand is close to the average of the SBTi approved scenarios, coal demand is higher than any of the SBTi approved scenarios and natural gas demand is close to the maximum demand for the SBTi approved scenarios. As the SBTi approved scenarios are a subset of the IPCC scenarios, this implies that for oil demand, the SBTi approved scenarios are a representative subset when compared to NZE2050 (as NZE2050 is close to the average in both comparisons). However, for coal and natural gas demand, NZE2050 is close to average for the IPCC scenarios but near or above the maximum for SBTi approved scenarios, suggesting that coal and gas demand are a significant component in determining whether a scenario is compliant with SBTi criteria.

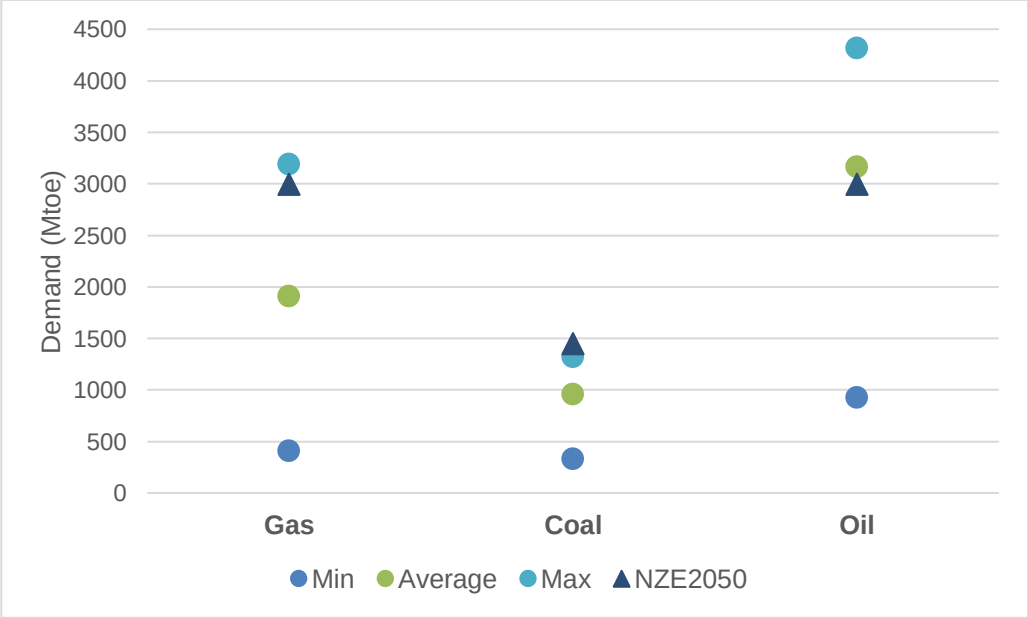

Figure 2: Minimum (min), average and maximum (max) natural gas, coal and oil demand (Mtoe) in 2030 for the 20 SBTi approved IPCC 1.5°C scenarios, compared to NZE2050.

It is important to note that while Figures 1 and 2 provide a comparison of fossil fuel demand in NZE2050 to other 1.5°C scenarios, the individual fuel demands are not internally consistent. For example, the maximum coal demand is unlikely to be from the same scenario as the maximum natural gas or oil demand, and it is likely that scenarios with higher than average demand for one fossil fuel will have lower than average demand for another to achieve net zero by 2050.

NZE 2050 vs NGFS. NZE2050 can also be compared to the Network for Greening the Financial System's (NGFS) 1.5°C scenarios[7], which were released in August 2020. The four 1.5°C scenarios are compared directly with NZE2050 in Figure 3, and fall into two categories:

1. Orderly: assumes climate policies are introduced early and gradually become more stringent, and full availability of carbon dioxide removal (CDR). This means that fossil fuels are able to be used for longer than if CDR was not available.

2. Disorderly: assumes climate policies are not introduced until 2030 and limited CDR is available. This means emissions reductions are sharper, as is the decline in fossil fuel demand.

Similarly to the comparison with SBTi approved scenarios, NZE2050 has higher coal demand than any of the NFGS scenarios. Oil demand is slightly lower than the lowest NGFS scenario, and natural gas demand is within 500 Mtoe of three of the NFGS scenarios.

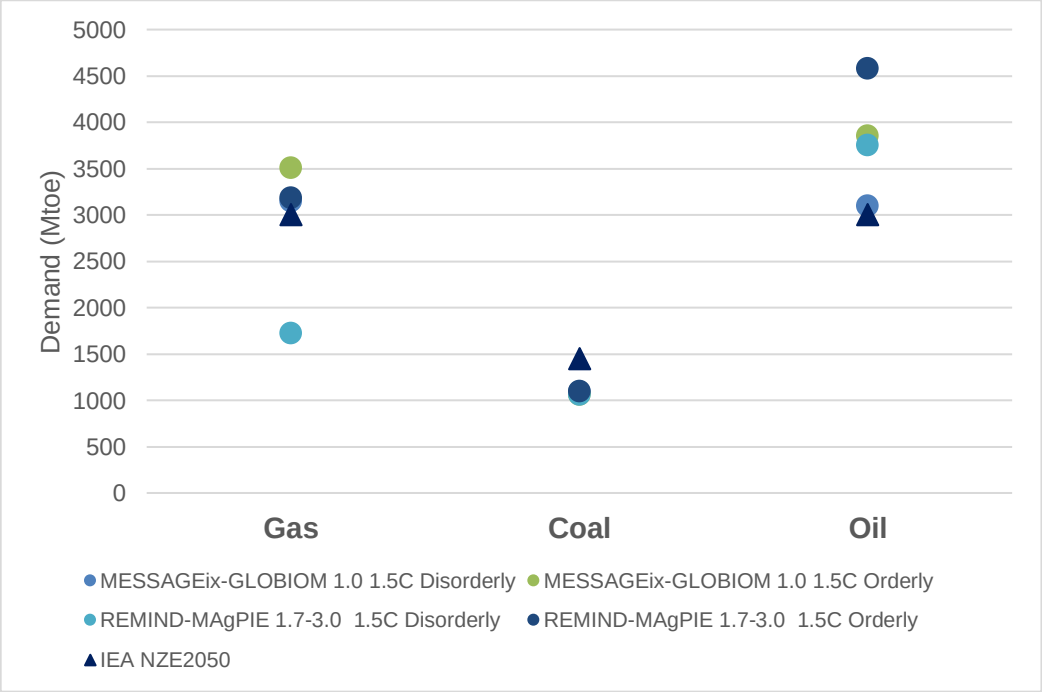

Figure 3: Natural gas, coal and oil demand (Mtoe) in 2030 for the four NGFS 1.5°C scenarios, compared to NZE2050.

Another significant component of the scenarios that impacts fossil fuel demand is the assumed technological and economic feasibility of CCS. Greater use of CCS means higher fossil fuel demand is possible while still meeting net zero by 2050. Figure 4 compares CCS demand across the 1.5°C scenarios. CCS in NZE2050 is below the average for all other scenario groups (IPCC, SBTi approved, NGFS) but above the minimum. This implies that IEA have been conservative with their estimates on CCS feasibility and demand by 2030.

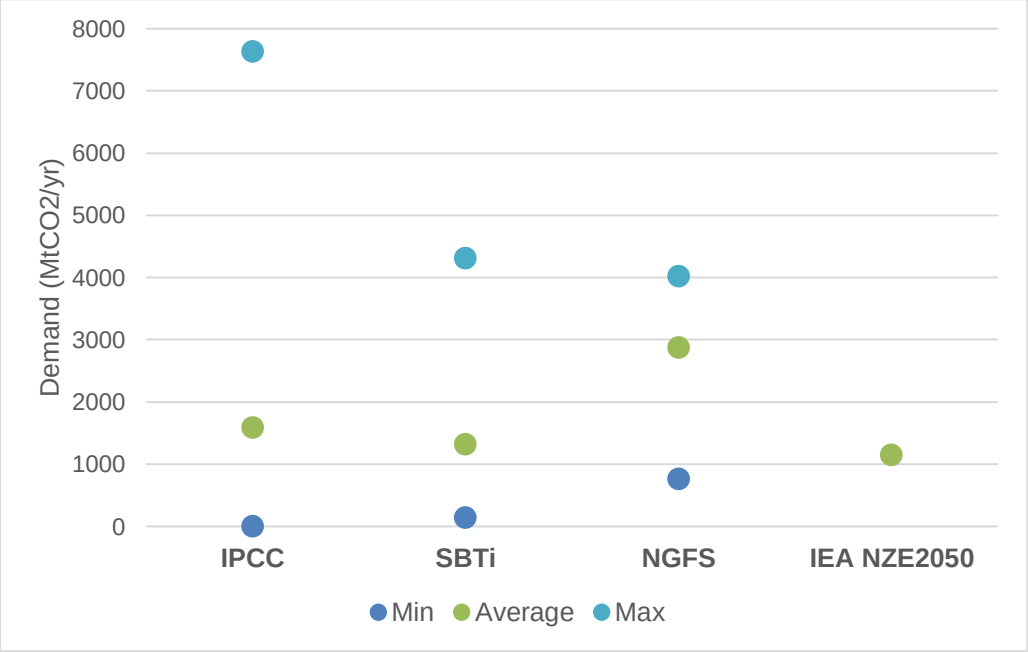

Figure 4: Minimum (min), average and maximum (max) CCS demand ($MtCO_2$/year) in 2030 for IPCC, SBTi approved and NGFS 1.5°C scenarios, compared to NZE2050.

COMMENTARY

NZE2050 is a welcome addition to the IEA's suite of energy scenarios, particularly for investors engaging with energy companies on climate change (e.g. through CA100+) given the IEA's strong standing with energy companies. The decarbonisation pathway set out in NZE2050 is significantly more ambitious than SDS and some of the IPCC 1.5°C scenarios by 2030. However, compared to the SBTi approved and NGFS scenarios, coal demand is still higher than all other scenarios. Oil demand is similar to the SBTi approved scenarios and lower than the NGFS scenarios. Natural gas demand is higher than the majority of SBTi approved scenarios and similar to three of the NGFS scenarios. CCS use appears conservative compared to other scenarios.

For companies to be able to use NZE2050 in their climate change reporting, IEA will need to:

1. Extend the time frame to 2050 and provide further detail and data, including at a regional level.

2. Ensure NZE2050 does not overestimate demand for coal and natural gas.

However, in the interim, investors should encourage companies that:

- Have disclosed a 1.5°C scenario - to consider the demand forecasts in NZE2050 in comparison with the scenario they are currently using until 2030, and ensure the scenario is at least as ambitious as NZE2050 in limiting fossil fuel demand, and if it is not, explain why a less challenging scenario was chosen.

- Haven't disclosed a 1.5°C scenario - to use a scenario at least as ambitious as NZE2050 by 2030, or as a minimum requirement, compare the demand forecast of NZE2050 to the most ambitious scenario disclosed and comment on the impact that a further reduction on fossil fuel demand would have on the resilience of their business.

Additionally, energy companies that have committed to net-zero emissions by 2050 but have not yet set short to medium-term emission reduction targets may find NZE2050 and the more qualitative information provided in Chapter 4 of the IEA WEO 2020 a useful resource.

RECOMMENDED FURTHER RESOURCES

1. **IEA WEO 2020 (IEA)**

   The 2020 report is firmly focused on the next 10 years, exploring the impacts of the COVID-19 pandemic on the energy sector, and the near-term actions that could accelerate clean energy transitions.

2. **Recommendations of the TCFD (Financial Stability Board)**

   Report establishes recommendations for disclosing information about the risks and opportunities presented by climate change. Scenarios are discussed in Section D.

3. **IPCC SR1.5 (IPCC)**

   Special report on impacts of global warming of 1.5C and related greenhouse gas emissions pathways.

4. **IEA World Energy Outlook: A critical review 2000-2020 (Dr Sven Teske, UTS Institute for Sustainable Futures)**

   Report examines WEOs from 2000-2020 and investigates assumptions and biases, which have led the IEA to overestimate the expected role of fossil fuels, nuclear power and CCS and underestimate the growth of renewables.

5. **WEO 2020: A small step when the world needs a giant leap (Oil Change International)**

   Article provides analysis on NZE2050 and recommends how the IEA can improve its scenarios in WEO 2021.

6. **Foundations of Target Setting (SBTi)**

   Section 3 of this report explains the requirements for SBTi to endorse a scenario. Appendix 1 identifies the scenarios that meet these requirements.

7. **NGFS Climate Scenarios for Central Banks and Supervisors (NGFS)**

   Document presents a set of scenarios developed to provide a common starting point for analysing climate risks to the economy and financial system.

ABOUT

Climate Action 100+ is an investor initiative to ensure the world's largest corporate greenhouse gas emitters take necessary action on climate change. More than 450 investors with more than $40 trillion in assets collectively under management are engaging companies on improving governance, curbing emissions and strengthening climate-related financial disclosures. The companies include 100 systemically important emitters, accounting for two-thirds of annual global industrial emissions, alongside more than 60 others with significant opportunity to drive the clean energy transition. Follow us on Twitter: @ActOnClimate100

CONTACT

Kate Simmonds
Analyst, Climate Action 100+
IGCC
E: **kate.simmonds@igcc.org.au**

Yong Por
Research Manager, Climate Action 100+
AIGCC
E: **yong.por@aigcc.net**