CLIMATE ANALYTICS

Fossil gas phase-out requirements in a 1.5°C world

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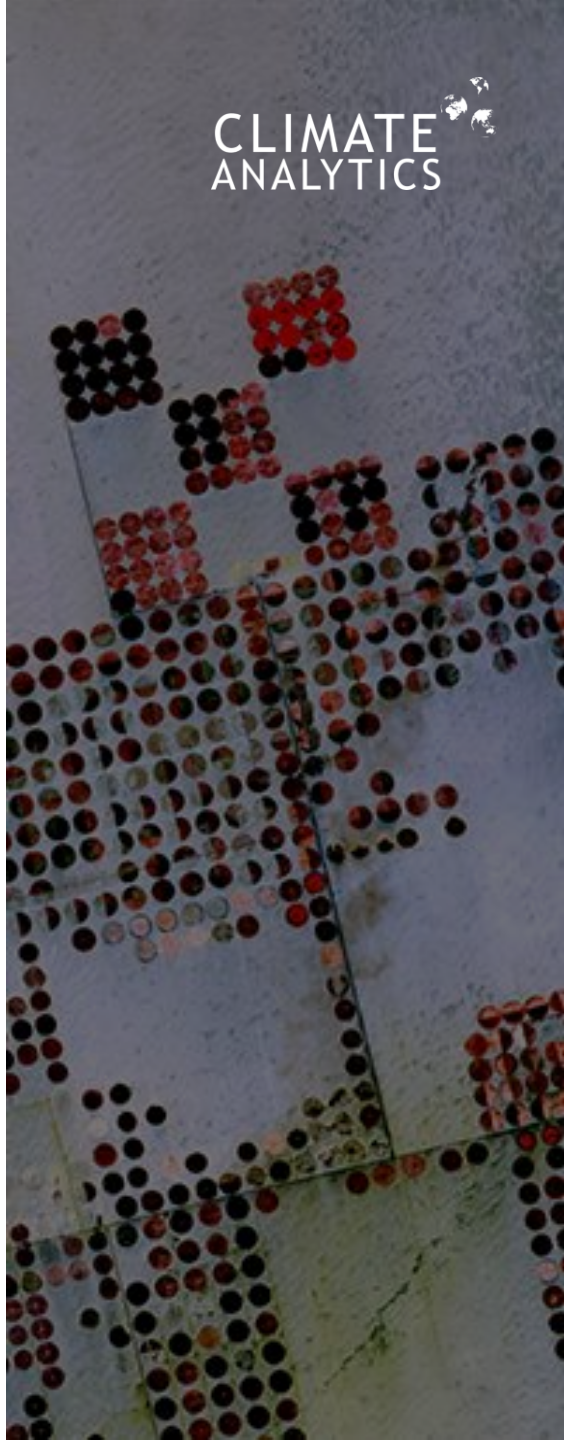
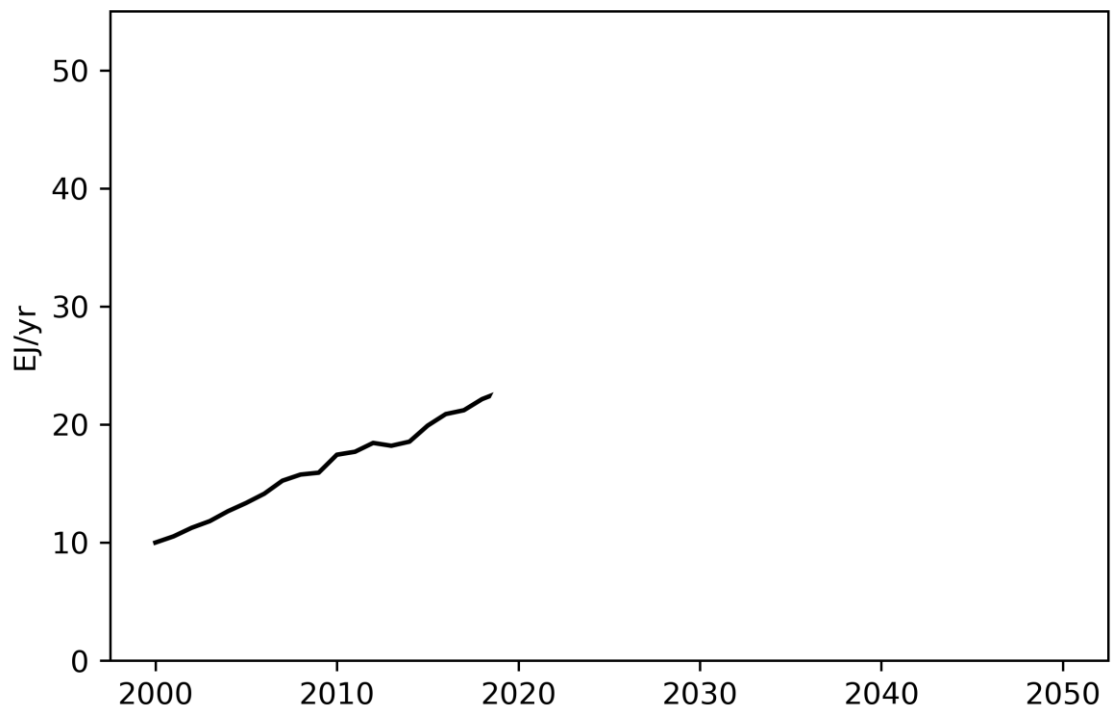
25th August 2022

Why fossil gas?

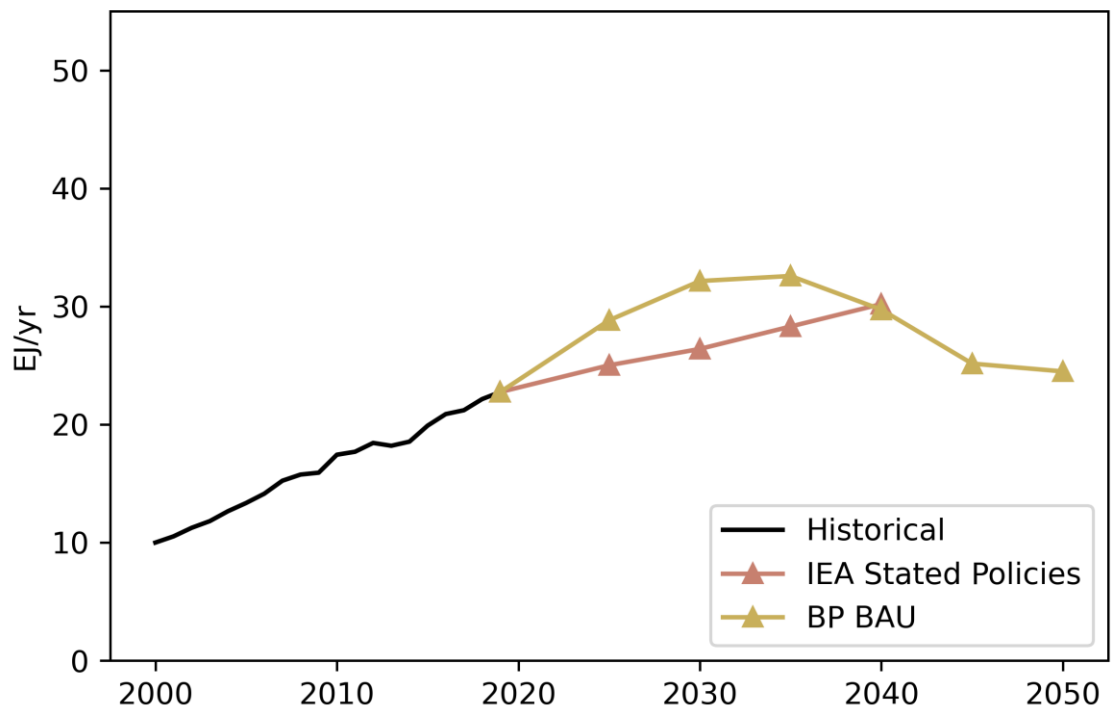
- While there is increasing pressure on coal phase-out, fossil gas has largely flown under the radar
- Proponents argue for a continuing role for fossil gas, e.g:
  - They claim it's a "cleaner" alternative compared to coal (coal-to-gas switching)
  - They see a role for "peaker" power plants in high-penetration VRE systems
- **But fossil gas is neither clean nor is it a bridging fuel**
  - Fossil gas has contributed to nearly 50% of growth in global fossil CO_2 emissions over the past few years.
  - A continued role for fossil gas as foreseen in the IEA's stated policies scenario is inconsistent with pathways for 1.5°C, and risks making fossil gas the "new" coal.
  - The war in Ukraine and the on-going energy crisis have made it clear that a clean energy transition is also a security matter.





Between 2000 and 2019, electricity generation from fossil gas increased at a rate of **4%/yr**, from 2774 to 6316 TWh.

Data source(s):
IEA World Energy Balances, 2020



Data source(s):
IEA World Energy Balances, 2020
IEA World Energy Outlook, 2020
BP Energy Outlook, 2020

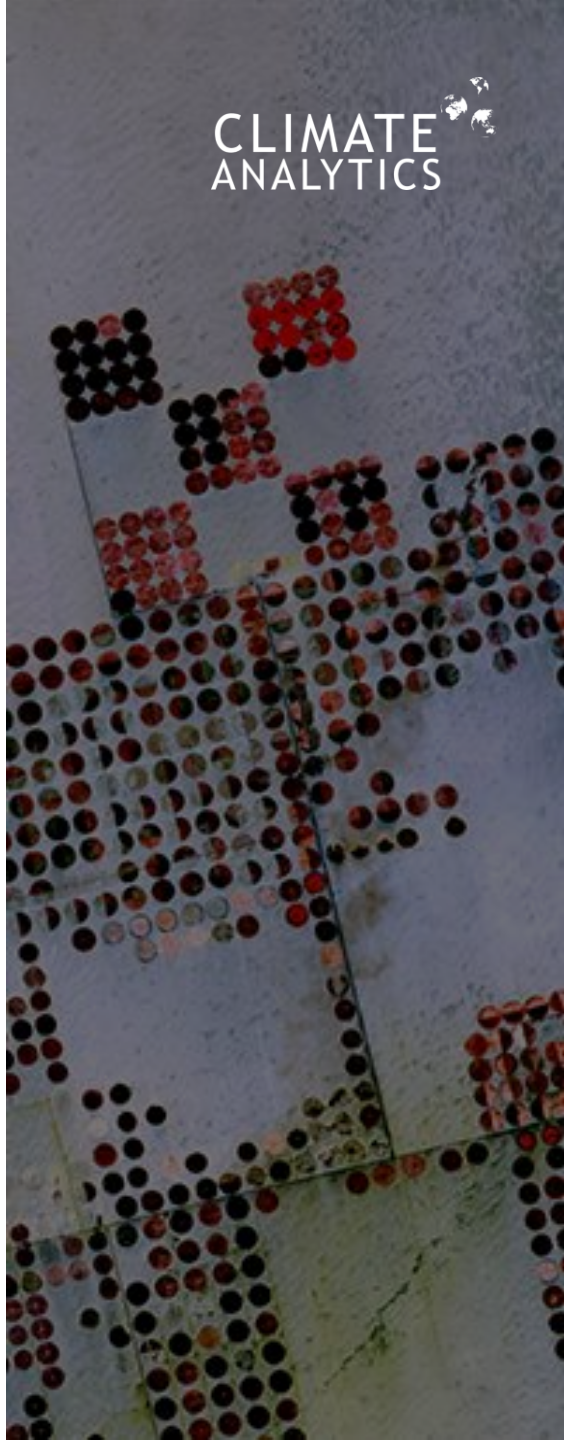
The **IEA's Stated Policies Scenario** sees a slower rate of growth between 2019 and 2040, with fossil gas generation reaching 8300 TWh.

BP's Business as Usual Scenario sees a more rapid rate of growth between 2019 and 2040.

But neither of these scenarios are consistent with the Paris Agreement's 1.5°C goal

Fossil gas phase-out in 1.5°C scenarios

- In IPCC SR15 pathways that meet sustainability criteria, unabated fossil gas electricity generation :
  - falls below **10%** of total electricity generation **before 2035**,
  - falls below **below 5%** of total electricity generation **before 2040,**
  - is effectively **phased out in all world regions by 2045**.
- Given the dramatic plummet in the cost of renewable energy, investing in new fossil gas generation in the 2020s carries the risk of creating stranded assets.



Fossil gas is phased-out shortly after coal

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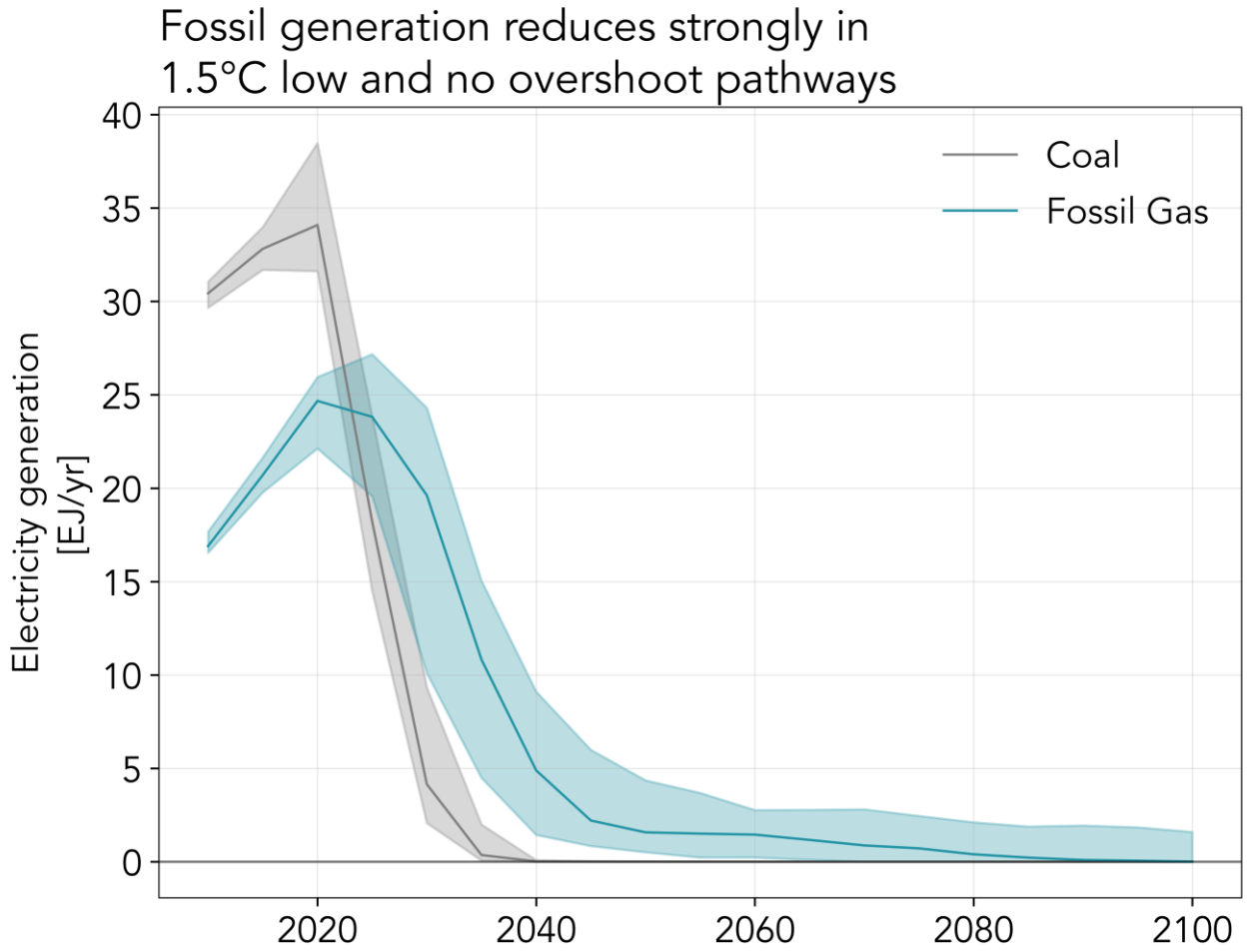
- The fossil gas phase-out date occurs at most 5-10 years after the coal phase-out date in both developed and developing economies.
- Fossil gas cannot have a role as a transition fuel in the power sector.

Region	Coal phase-out date	Effective gas phase-out date
OECD	2030	2035
Non-OECD Asia	2035	2040
Latin America	2030	2030
Middle East and Africa	2035	2045
Eastern Europe and former Soviet Union	2030	2040

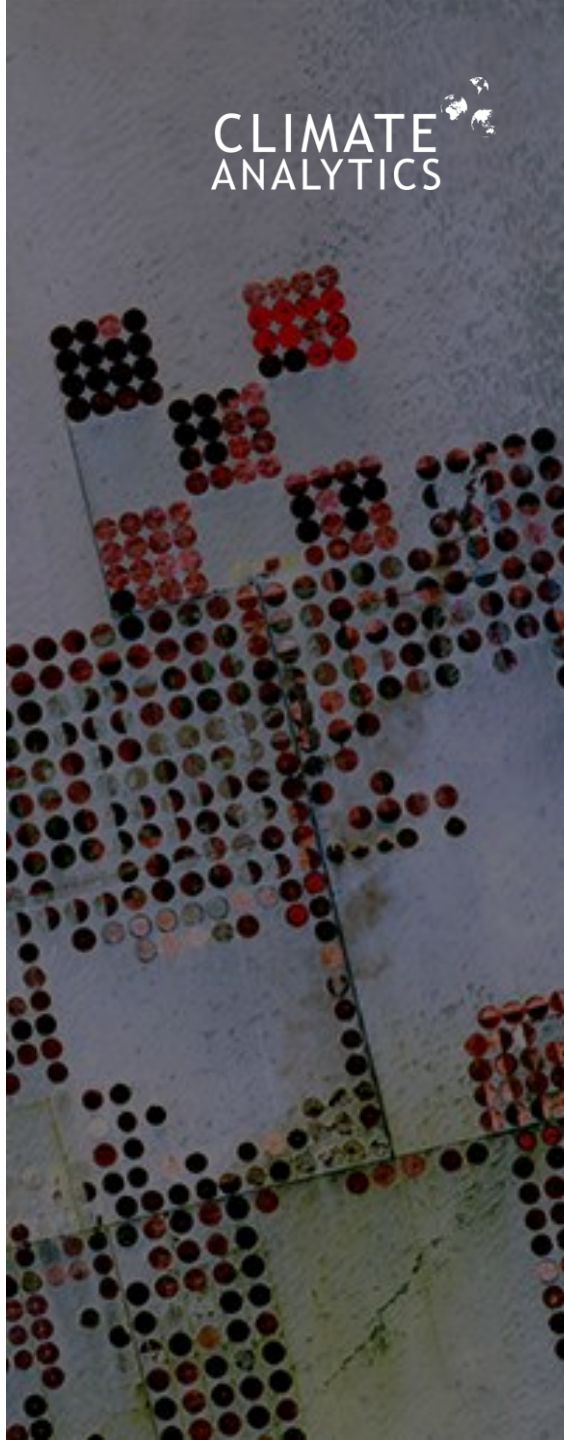
The IPCC's latest AR6 scenarios show an even faster gas phase-out

- Pathways from the IPCC's 6th assessment report, selected using the same sustainability constraints, show an even earlier phase-out date, by **around 2040**.
- A rapid phase-out of fossil gas from the power sector is becoming both **more urgent**, due to rising emissions, and **more feasible**, due to the falling costs of renewables and storage.



Focus on unabated gas in the power sector

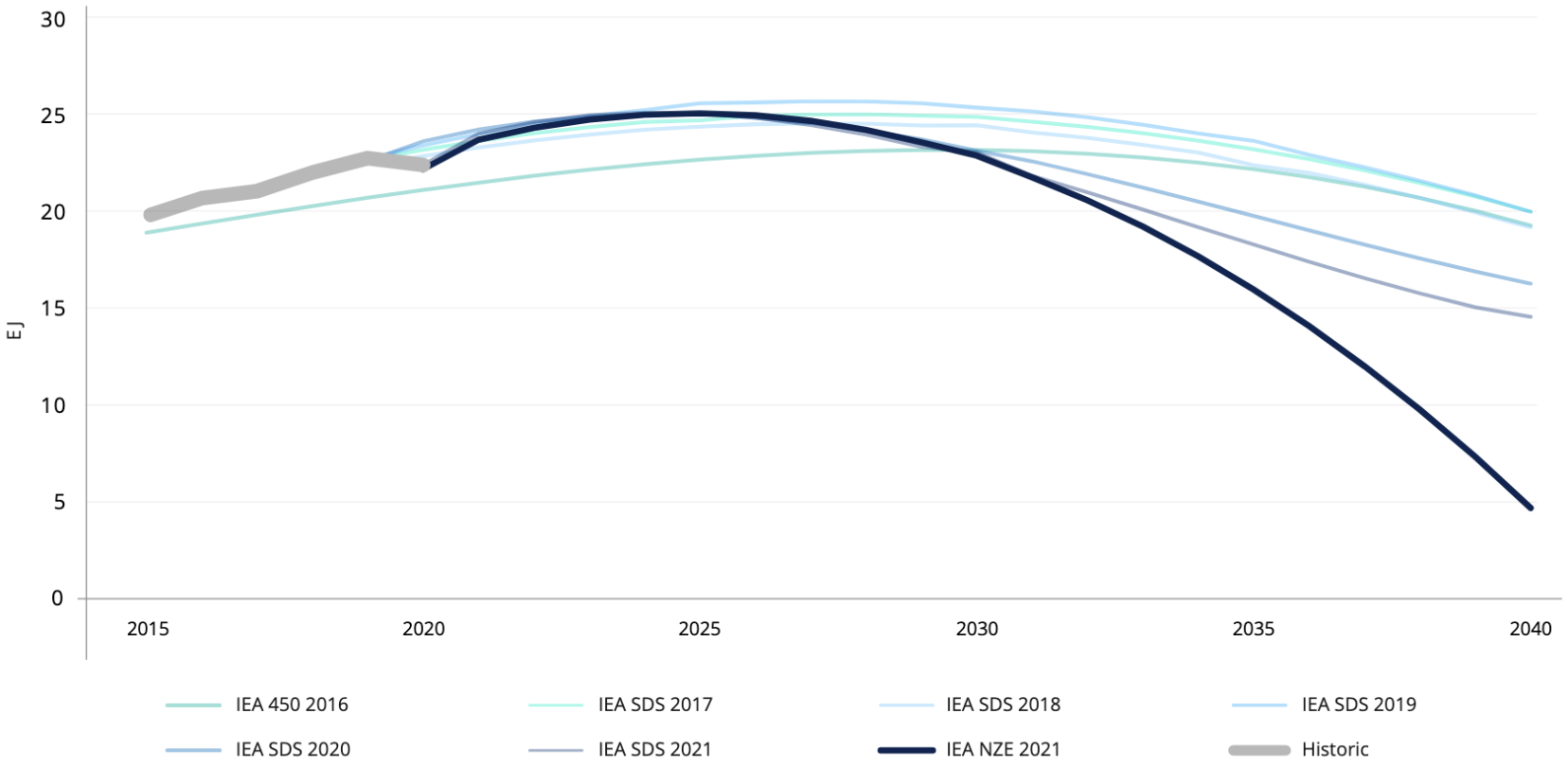
- We focus on fossil gas power generation without CCS
- CCS has has a very limited role in the power sector in the scenarios we assess
- This small role is unlikely to be necessary given range of cost effective alternatives for providing dispatchable low-carbon power (e.g. hydrogen turbines, geothermal and long-duration storage)
- Challenges for fossil gas + CCS include the energy penalty of CCS, the high marginal costs of fossil gas, incomplete carbon capture and methane emissions during production and transport.



Fossil gas use declines in successive IEA scenarios

- IEA scenarios are often criticized for conservative assumptions over the costs and availability of zero carbon alternatives.
- Successive IEA scenarios show steeper declines in fossil gas power.
- The IEA's Net Zero scenario – shows a much steeper fall in fossil gas power than previous IEA sustainable development scenarios, broadly in line with IPCC 1.5°C scenarios.

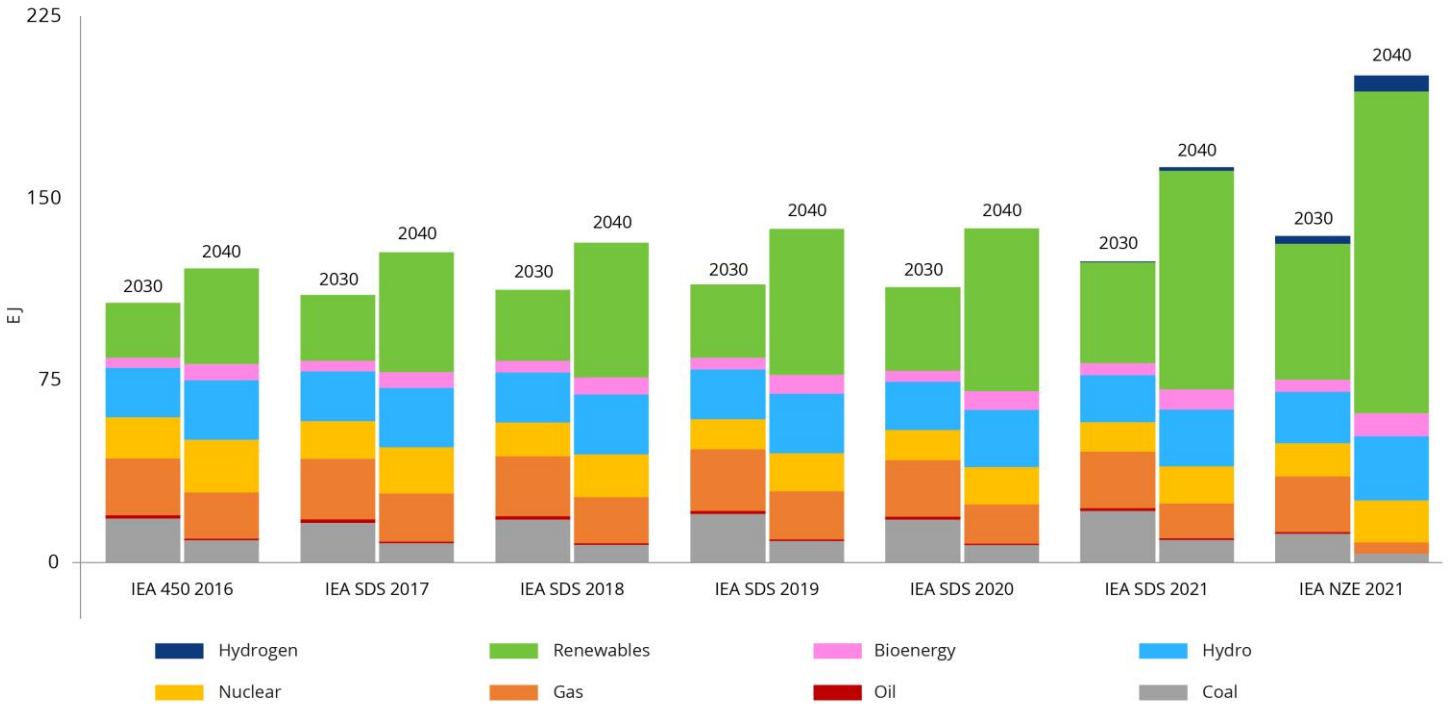
Historic and projected fossil gas power generation in successive IEA scenarios (published 2016-2021)



Renewables + storage are an increasingly cost-effective alternative

- The deployment of renewables and storage increases dramatically over this decade and next in 1.5°C compatible pathways.
- E.g. solar PV and wind capacity increases around five-fold between 2020 and 2030 in the IEA's Net Zero Scenario, reaching around 8000 GW in 2030
- Dramatic cost reductions in RE and storage mean these are expected to continue to increase in cost effectiveness

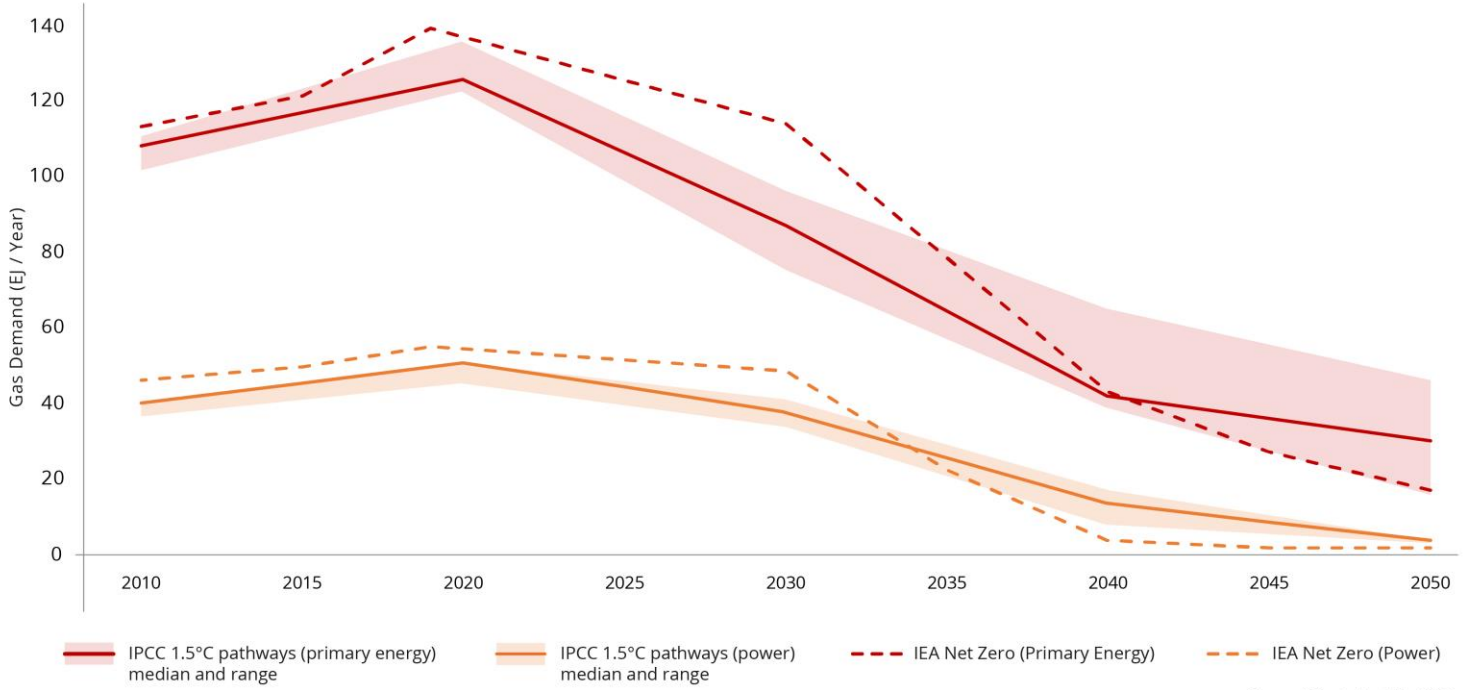
Figure 5: Projected power generation mix in 2030 and 2040 under different IEA scenarios



Source: Climate Analytics, 2021c

Fossil gas in primary energy should already have peaked and be declining globally

Figure 3: Unabated fossil gas use in total primary energy and electricity under 1.5°C compatible scenarios compared with the IEA's Net Zero scenario



Source: Climate Analytics, 2021c

- Both the IEA and IPCC 1.5°C scenarios show declines in total fossil gas consumption.
- The slower decline in the IEA's Net Zero Scenario reflects more conservative assumptions over the availability of low carbon alternatives for non-electricity fossil gas applications.

Important context

- Achieving a rapid fossil gas exit in many developing countries will require financial, technical and, depending on the circumstances, transitional **support** from developed countries.
- The legal and ethical basis of this stems from the principle of *common but differentiated responsibility and capability* that underpins the climate regime and is encoded in the Paris Agreement.

Important context (cont'd)

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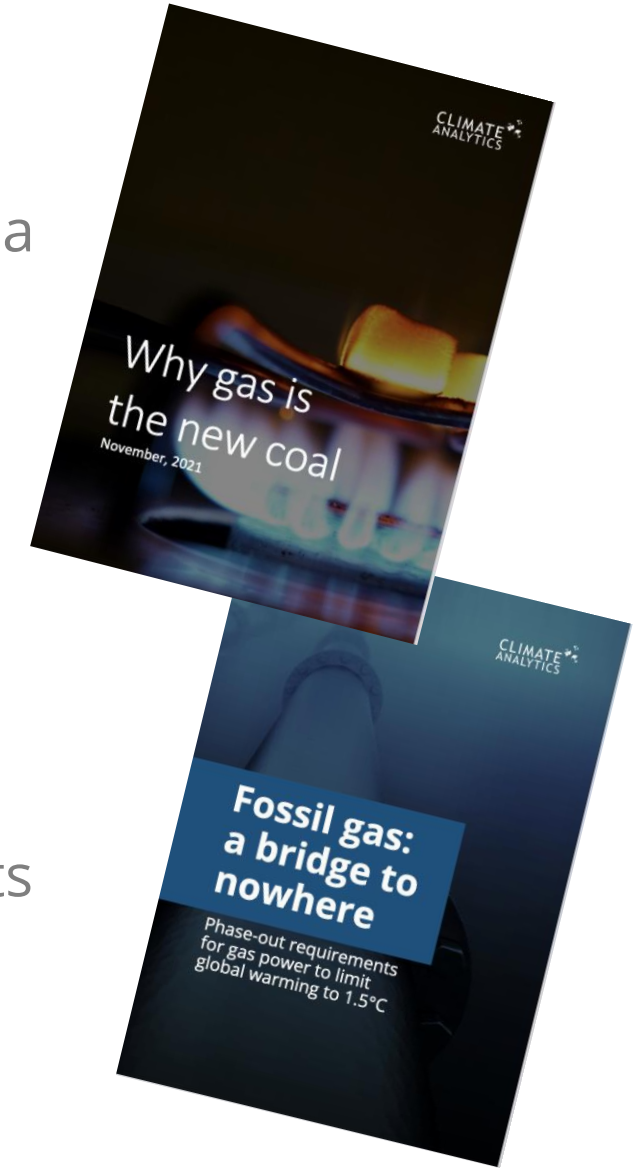
- Gas phase-out dates need to be considered in the context of **sustainable development objectives and risks**
  - e.g. the risk of stranding of infrastructure and other assets in the face of continually declining costs of renewables and storage, and the challenges posed by volatile fossil fuel prices.
- The global scenarios we've assessed tend to show **slower transitions** than bottom-up models and are often criticised for using **conservative cost assumptions** for renewable energy.

Key take-aways

- Fossil gas is not a transition fuel. The latest scenarios show a global phase-out by around 2040, not long after coal.
- This analysis did not take into account recent gas price increases and volatility, which highlight the increasing urgency of a transition to renewables.
- A rapid phase-out of fossil gas from the power sector is becoming both more urgent, due to rising emissions and security concerns, and more feasible, due to the falling costs of renewables and storage.



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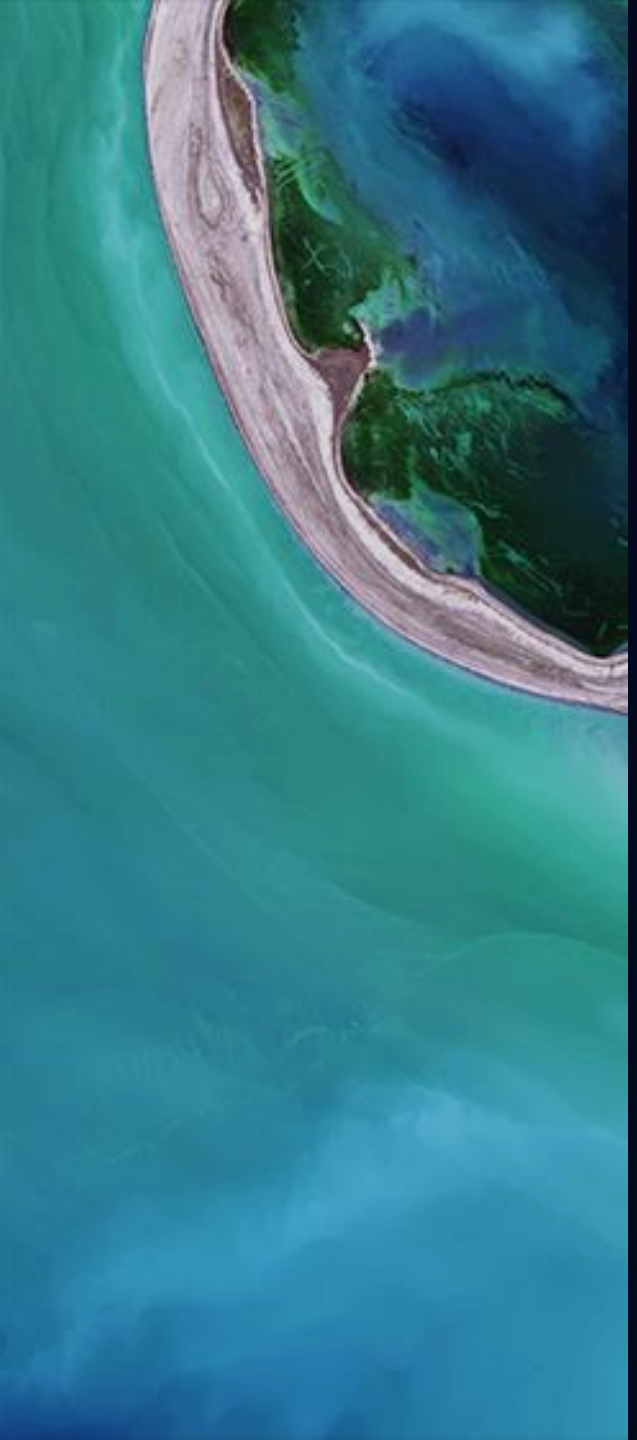

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Extra slides

Regional fossil gas phase-outs

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OECD

- Rapid decline this decade; effective phase-out by mid-2030s (consistent with IEA NZ scenario)
- European countries in particular face increasing security challenges
- But many countries are still investing in fossil gas -> risks locking in high carbon infrastructure

Latin America

- Earliest phase-out, likely due to high share of renewables (especially hydro, which is vulnerable to climate change impacts but is transitioning towards supporting VRE systems)
- Renewables experienced record growth in 2021.

Regional fossil gas phase-outs

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Non-OECD Asia

- Gradual decline in 2020s in 1.5 pathways, which accelerates in the 2030s to reach an effective phase-out by 2040.
- Existing plans to transition from coal to gas come with a high risk of stranding assets.
- Very high untapped renewables potential across the region will be fundamental for improving electricity access.

Eastern Europe and former Soviet Union

- Effective phase-out by 2040 in 1.5 pathways.
- Many countries in this region are reliant on fossil fuel imports.
- Renewables, energy efficiency and electrification provide an increasingly economic and stable alternative to fossil fuels, but many countries will need financial support to scale them up rapidly.

Regional fossil gas phase-outs

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Middle East and Africa

- Currently the region with the highest share of gas in the power sector, but high variation in the power mix across the region.
- 1.5 pathways show only 10% of power from gas by late 2030s, and effective phase-out by mid 2040s. Investing in fossil gas infrastructure risks creating stranded assets.
- Access to electricity needs to increase in many countries– renewables are an economic and versatile option.
- A rapid scale-up of renewables and resilient power grids will require investment from wealthier countries.

Methods in brief

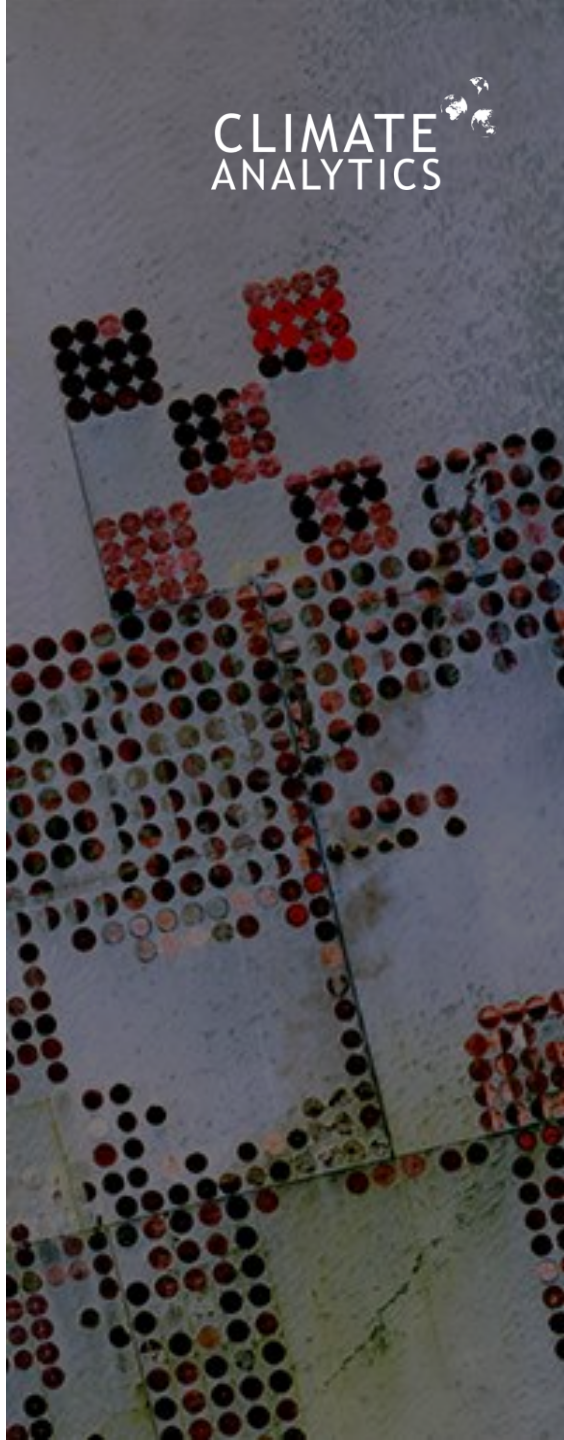
- Pathways used: ”**no and low overshoot**” scenarios from the IPCC’s SR1.5 (n = 53) + scenarios published since SR1.5, including scenarios from Strefler et al., (2020) and the Network for Greening the Financial System (NGFS) scenarios
- For the scenarios that do not report sufficient data to assess whether they are “no or low overshoot scenarios”, we assess their temperature outcomes using the reduced complexity carbon cycle and climate model MAGICC6
- The resulting scenario ensemble consists of 63 “no and low overshoot” scenarios
- We then apply **sustainability criteria** to select scenarios (n = 19) for our benchmarking exercise.
- Additional **preliminary analysis of AR6 scenarios** that meet the same criteria, focused on global level only.

Table 1 *Description of filters used to select benchmarking ensemble*

Criterion	Threshold Selected	Justification
Climate outcome	SR1.5 categories: “Below 1.5°C” and “1.5°C low overshoot”	The only emissions pathways from the IPCC SR1.5 report that are in line with the Paris Agreement LTTG are those categorised as “no or low overshoot 1.5°C pathways” that are “as likely as not” to limit peak warming to below 1.5°C throughout the 21st century (with a probability of more than 33%) and to limit warming to below 1.5°C in 2100 with at least 50% chance. Pursuing such an emissions reduction pathway would also give a ‘very likely’ (>90%) probability of not ever exceeding 2°C, in line with the interpretation of ‘well below 2°C’ as a ‘*defence line that needs to be stringently defended*’. We explore this further in Annex I.
BECCS deployment within sustainability constraints	5 Gt CO_2 / yr by mid-century	Sustainability thresholds are applied for bioenergy with carbon capture and storage (BECCS) and carbon uptake drawing from estimates published by Fuss and others in (Fuss, Lamb, Callaghan, Hilaire, Creutzig, Amann, Beringer, Minx, et al., 2018), where the mid-century threshold is applied to the average of the 2040-2060 value from the scenario ensemble, following the approach we have previously adopted in (Climate Analytics, 2019).
Afforestation/reforestation within sustainability constraints	3.6 Gt CO_2 / yr removal by mid-century	
Energy efficiency	At least 0% increase in final energy demand in 2050 relative to 2018 levels	Warszawski and others define several mitigation levers, and associated thresholds for “reasonable” and “speculative” use of these thresholds. The use of these levers to further down-select the ensemble helps to capture the balanced use of several mitigation options, without an excessive reliance on any one.
Carbon intensity of energy	At least 75% below 2018 levels by 2050	

Defining phase-out thresholds

- We present the results for different thresholds, i.e., when the share of fossil gas in the region falls below 5%, 2.5%, and 1% of electricity generation.
- We refer to the **"effective phaseout"** as the year when the share of natural gas generation **falls below 2.5%,** and the **"total phaseout"** as the year when the **share falls below 1%.**
  - Sector-based bottom-up models with explicit unit-level representation see complete phaseouts in high mitigation scenarios.
  - We use a definition of "phase-out" that is more in line with the characteristics of electricity systems than an "absolute zero" from models' results.
  - An "effective phaseout" at 2.5% indicates the year when remaining natural gas assets **will play a very specific role in the electricity system**, but will effectively be phased out as alternatives (e.g., battery storage) are phased into the system as a replacement.



Earlier coal phase-out dates in updated scenarios

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Region	2019 Report Phase-out Date Coal (Median of pathways)	Updated Coal Phase-out Date (Median of pathways)
OECD	2031	2029
Non-OECD Asia	2037	2034
Latin America	2032	2030
Middle East and Africa	2034	2034
Eastern Europe and Former Soviet Union	2031	2030

Updated scenarios account for delayed action to-date and declining costs of renewables

Ember analysis of AR6 scenarios: *"we have less time to phase out coal, and wind and solar have even greater potential to help us achieve this"*