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Commodity Insights

CO₂ Reductions in North America versus Abroad

The Energy Council

2023 Global Energy and Environmental Issues Conference

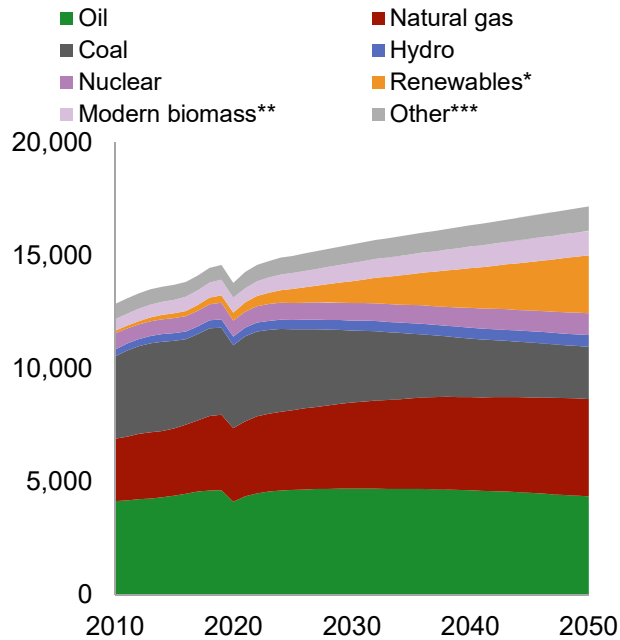
Deb Ryan, Head of Strategic Commodities, Centre of Emissions Excellence

December 2023



The view from 2021: Fossil fuel demand set for slow decline as renewables grow, but Paris Agreement targets appear out of reach

Global TPED by fuel, Inflections base case outlook 2021 (MMtoe)

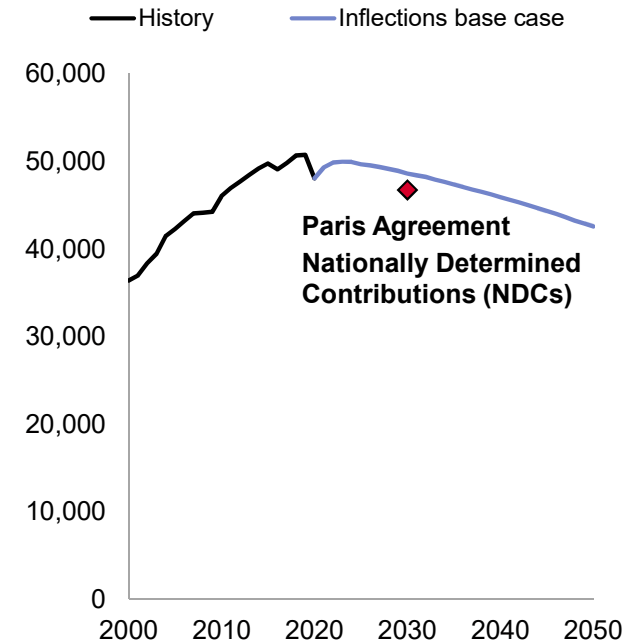


Data compiled September 2023
 * Includes solar, wind, geothermal, and ocean energy.
 ** Includes biofuels and biomass (industry, electricity, district heat, and refining).
 *** Includes solid waste, traditional biomass, ambient heat, net trade of electricity, or heat
 Source: S&P Global Commodity Insights
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Global key energy metrics % change 2050 vs. 2021

| Total primary energy demand | |
|-----------------------------|-------|
| Oil | +0% |
| Gas | +30% |
| Coal | -39% |
| Power generation | |
| Total | +88% |
| Wind | +558% |
| Solar | +929% |
| Nuclear | +35% |
| Fossil fuels | -4% |

Global GHG emissions 2000 - 2050, Inflections base case outlook 2021 (MtCO₂e)

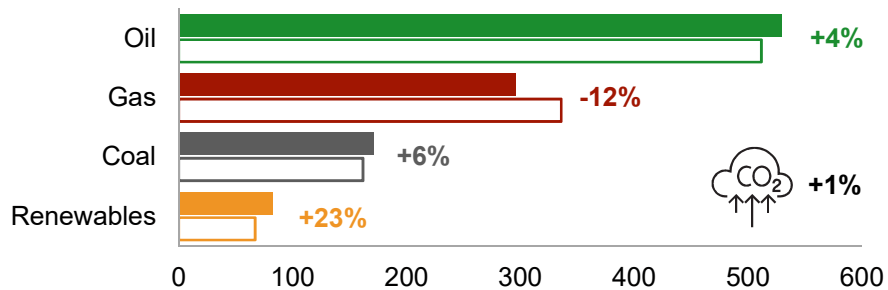


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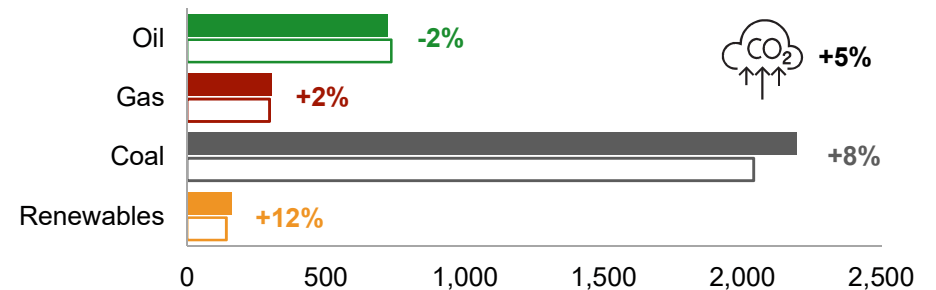
2022 confounded expectations: fossil fuel consumption and emissions were higher than expected, but so too was demand for renewables

Global & regional Oil, Gas, Coal & Renewables demand 2022, Inflections 2021 forecast vs. actual (MMtoe)

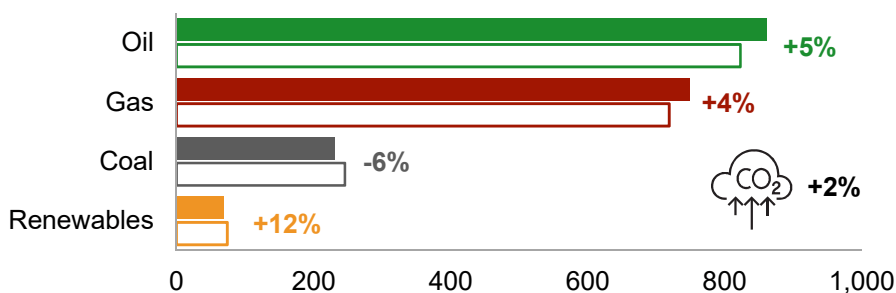
European Union



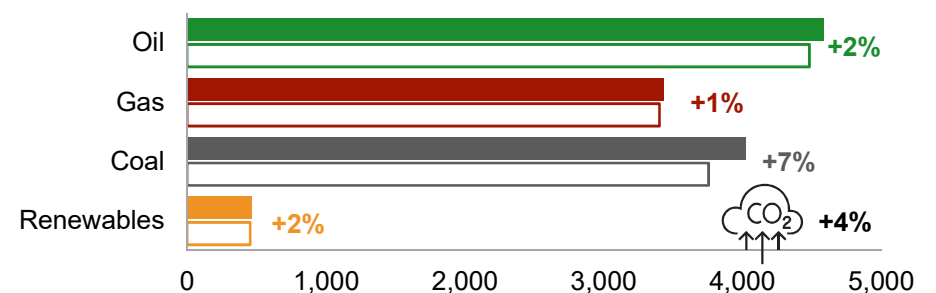
China



United States



World

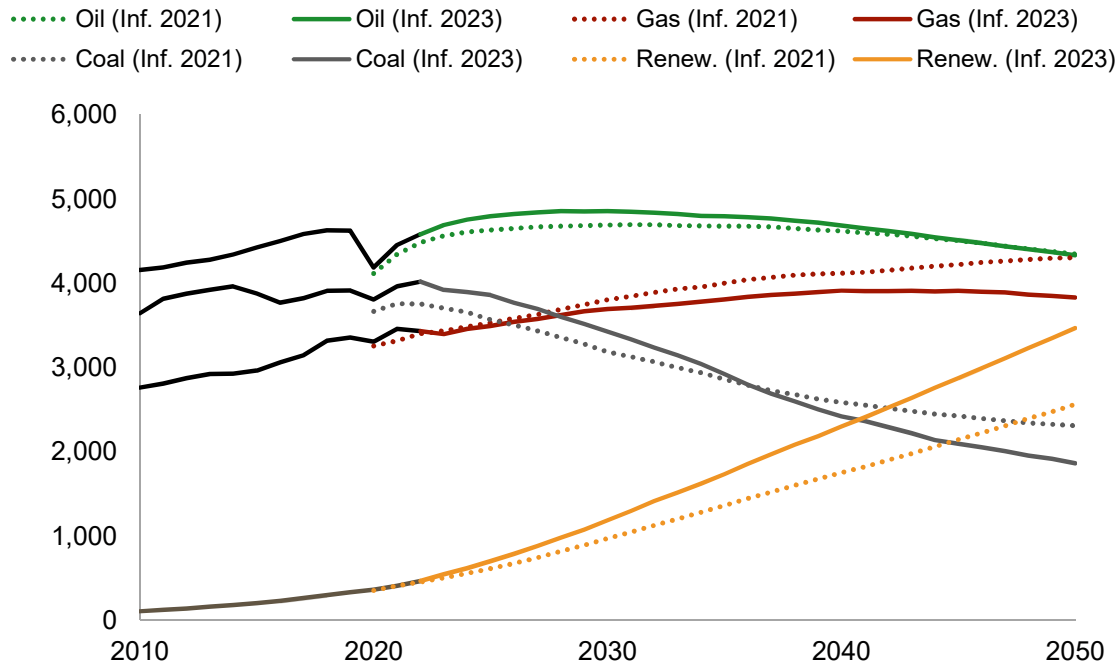


Data compiled September 2023
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█ █ █ █ 2022 (Inflections 2021 forecast)
 █ █ █ █ 2022 (actual)

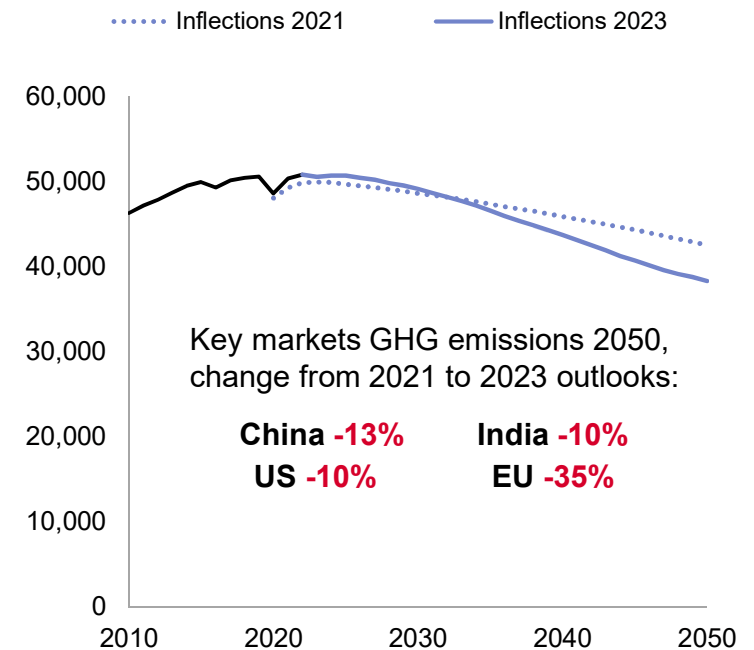
The events of 2022 will have long-term impacts: faster declines in demand for fossil fuels and emissions of GHGs, and accelerated growth for renewables

Global Oil, Coal, Gas & Renewables demand 2010 - 2050, Inflections 2021 vs. Inflections 2023 (MMtoe)



Data compiled: September 2023
 Source: S&P Global Commodity Insights, Energy and Climate Scenarios
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Global GHG emissions 2010 - 2050, Inflections 2021 vs. Inflections 2023



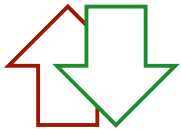
Diverse futures, but common themes across the five outlooks



- **Industrial policy is turbocharging cleantech investment**



- **The Ukraine conflict will permanently reduce European demand for fossil fuels**



- **A two-trajectory Asia Pacific is emerging**

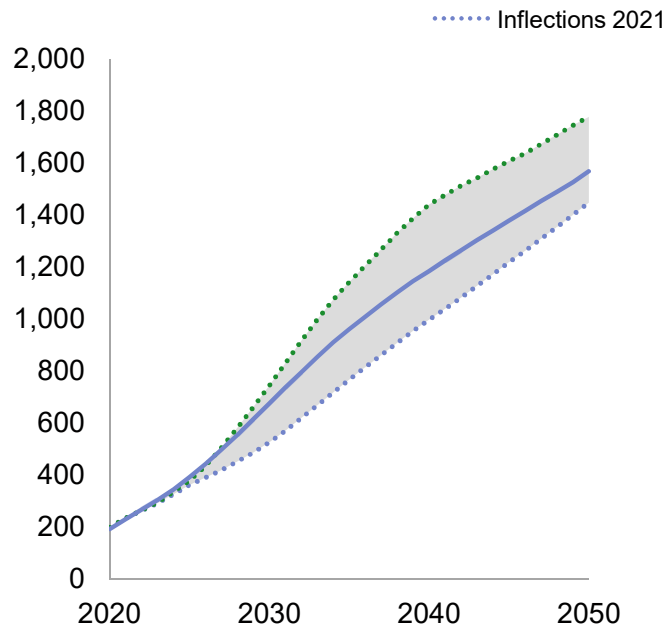


- **Renewables will represent more than half of total global power generation by 2050 under the Inflections base case**

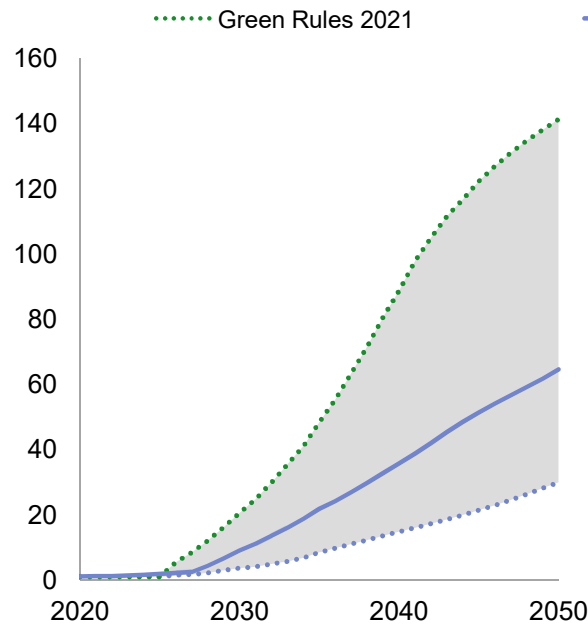
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In the United States, the Inflation Reduction Act has driven a material uplift in expectations for renewable and battery storage capacity growth

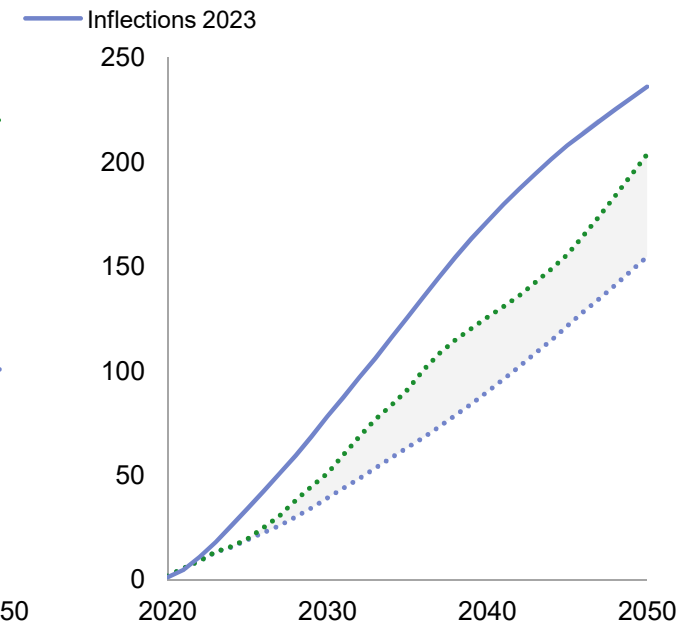
US renewable power* capacity, 2020 - 2050 (GW)



US low-carbon hydrogen production, 2020 - 2050 (MMtoe)**



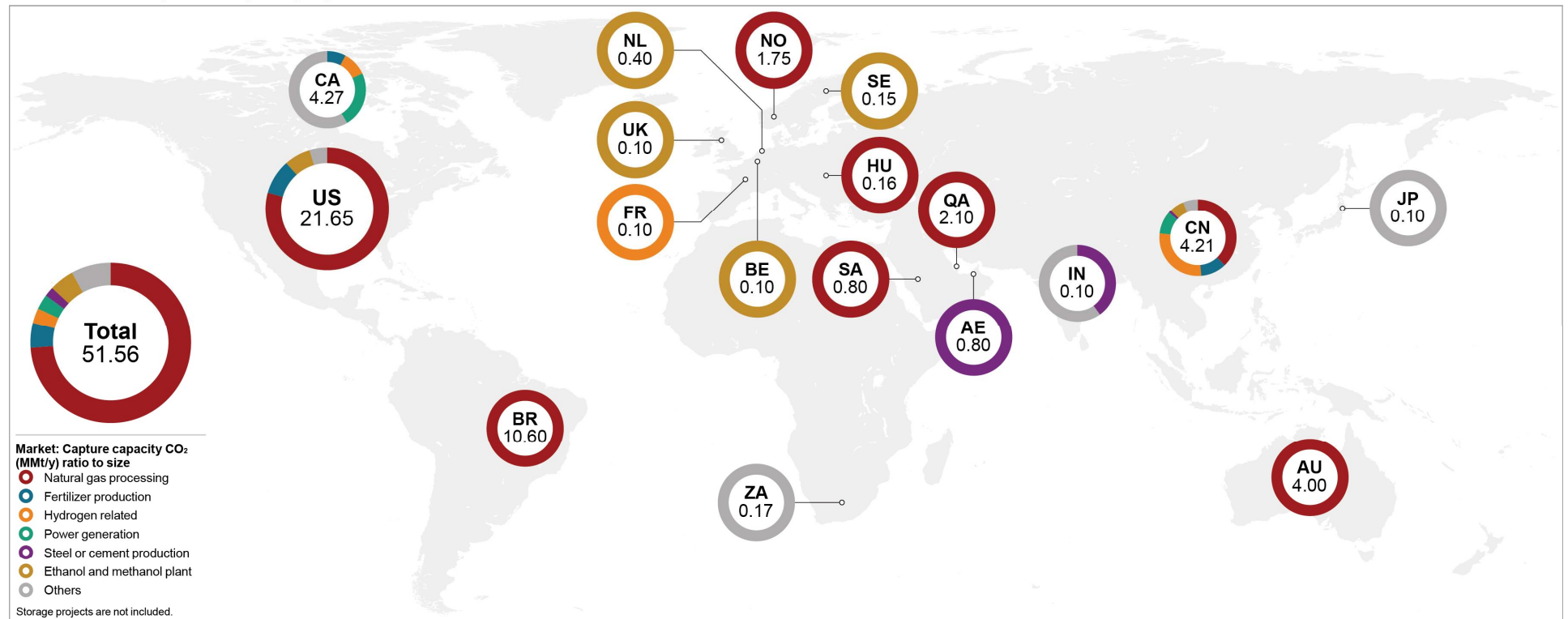
US battery storage capacity, 2020 - 2050 (GW)



Note: *Renewable power = Wind + Solar; **low-carbon hydrogen production = blue + green hydrogen
 Data compiled September 2023
 Source: S&P Global Commodity Insights
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Most of the current CO2 capture capacity is in the Americas, with the US accounting for 42% of the capacity, mainly from natural gas processing

Current CO2 capture capacity by emission source



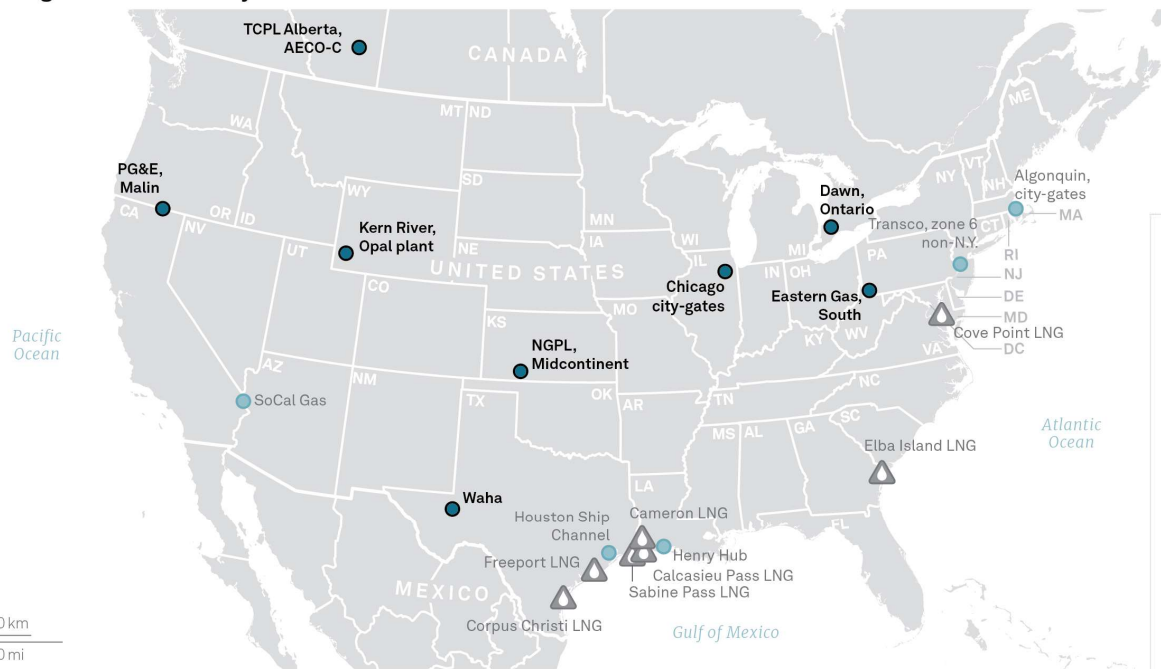
Data compiled Aug. 10, 2023.

Source: S&P Global Commodity Insights: 2010509.

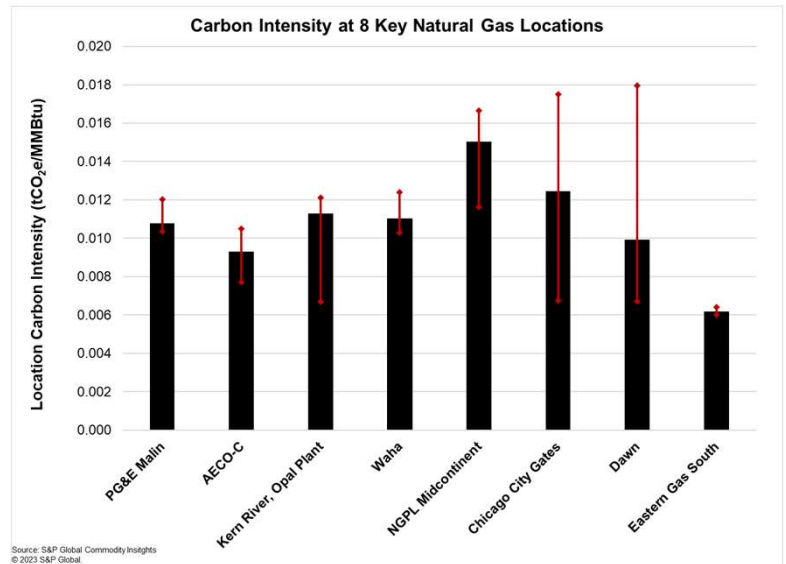
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Understanding how carbon intensity varies across production areas and how decarbonization methods will vary based on operations

Natural gas carbon intensity assessment locations



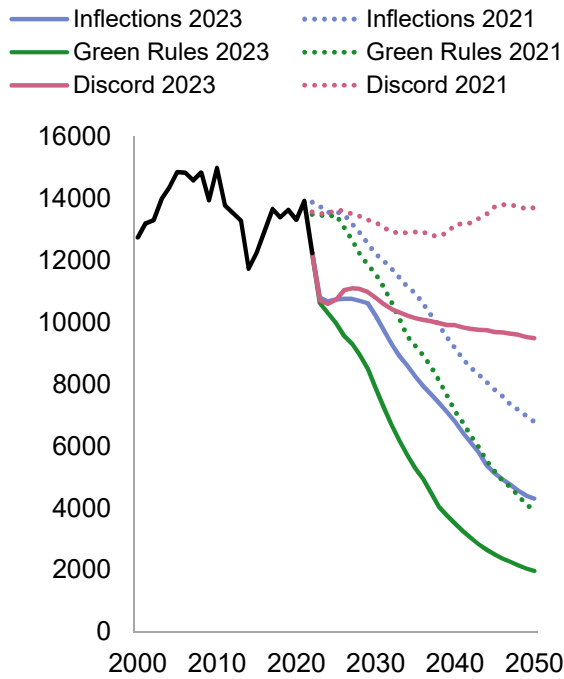
Source: S&P Global Commodity Insights



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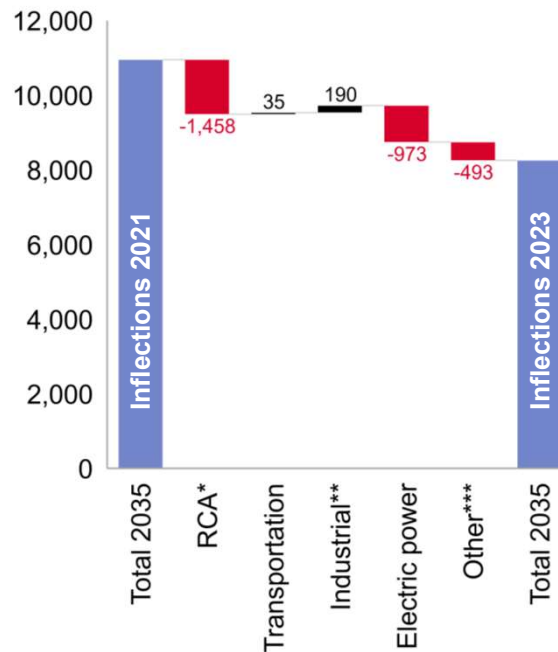
The European Union's response to the Ukraine war will drive down gas demand and accelerate renewables growth

EU natural gas demand, 2000 – 2050 (Bcf)



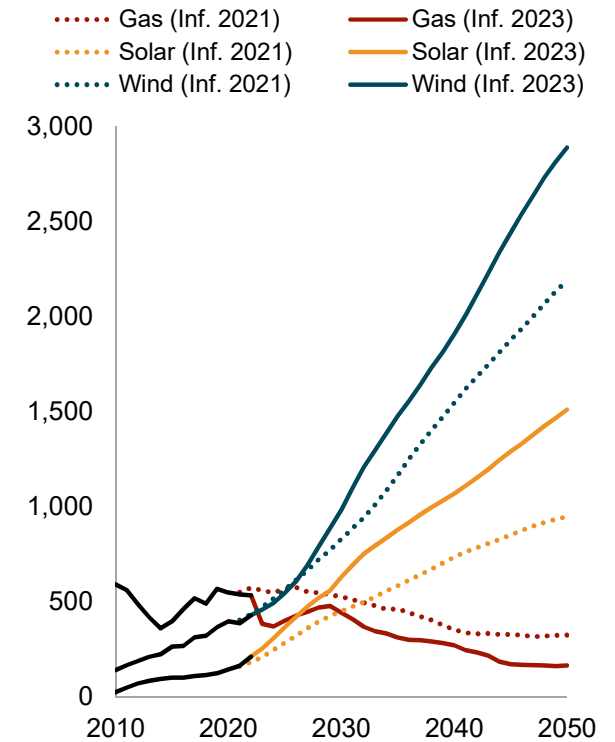
Data compiled July 2023
Source: S&P Global Commodity Insights

EU natural gas demand 2035, change between forecasts (Bcf)



* RCA = Residential / Commercial / Agricultural
** Includes feedstocks
*** Includes hydrogen production, energy sector uses, distribution losses and statistical differences

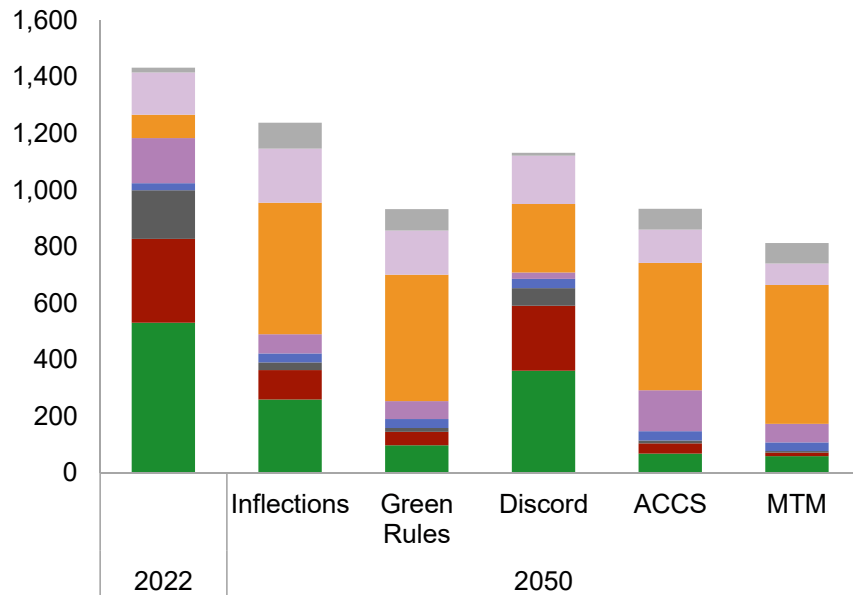
EU power generation select fuels, Inf. 2021 vs Inf. 2023 (TWh)



The EU will decarbonise faster and to a greater degree than any other region. But long-term climate targets remain highly ambitious

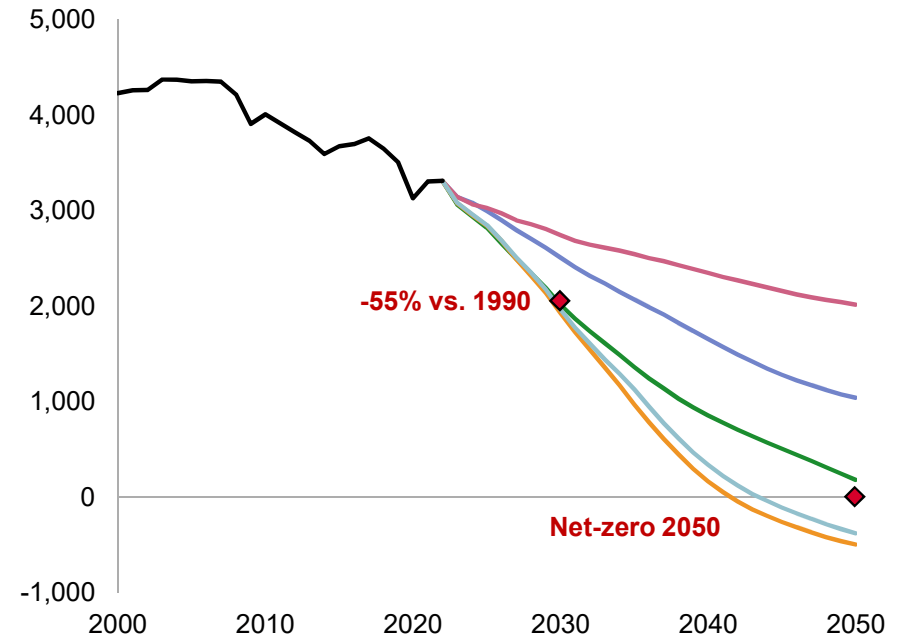
EU total primary energy demand by fuel, 2022 & 2050 (MMtoe)

Oil Natural gas Coal Hydro Nuclear Renewables Modern biomass Others



EU GHG emissions, 2000 - 2050 (MtCO₂e)

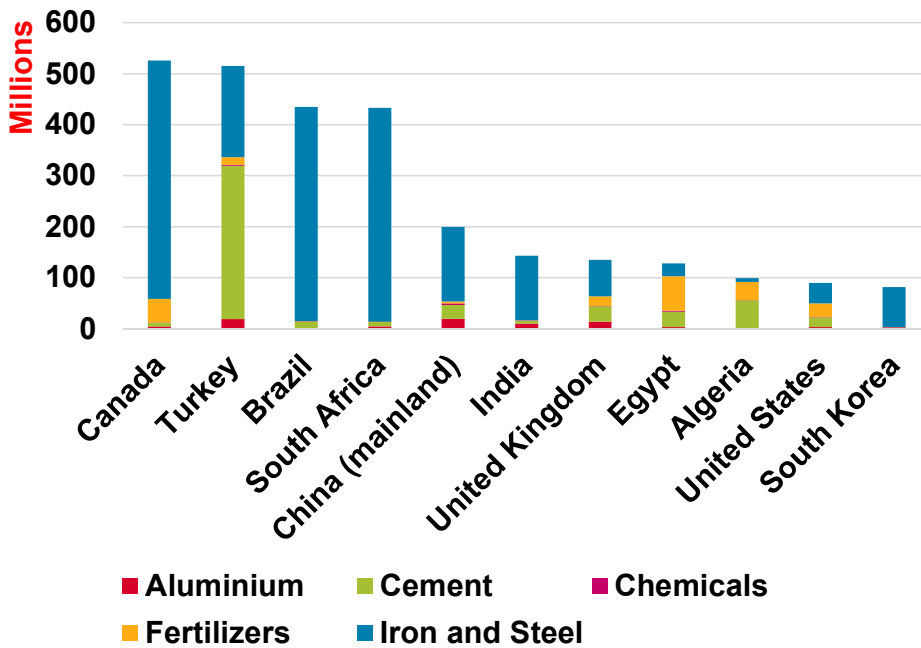
Inflections Green Rules Discord ACCS MTM History



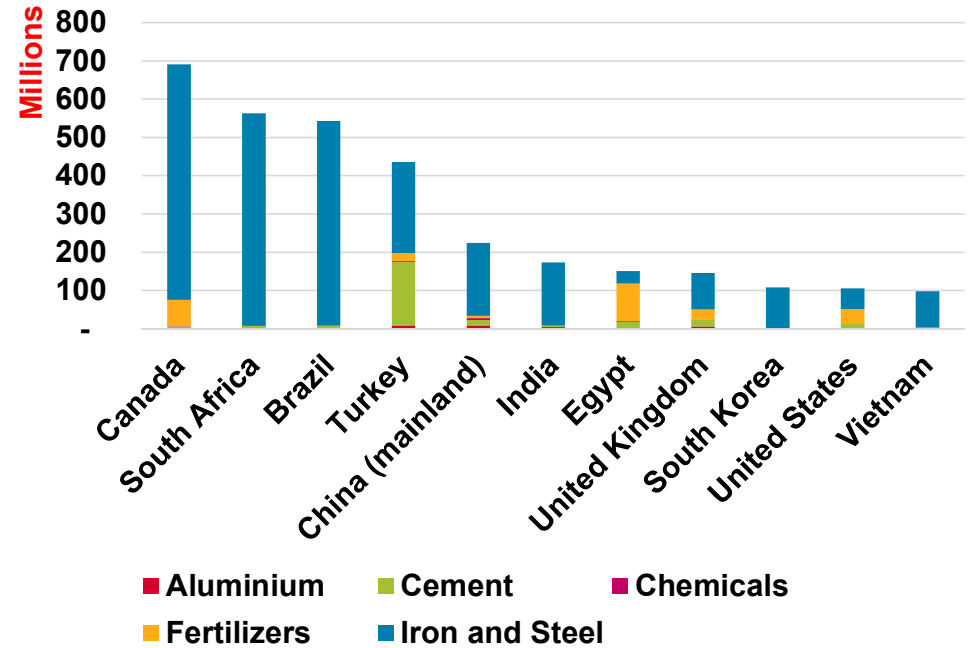
Data compiled July 2023
Source: S&P Global Commodity Insights

Canada, South Africa and Brazil to produce most CBAM emissions. Turkey's CO2 exposure reduced by export of lower carbon intensity goods to EU market

Volume CBAM covered products by ton
2026-2040

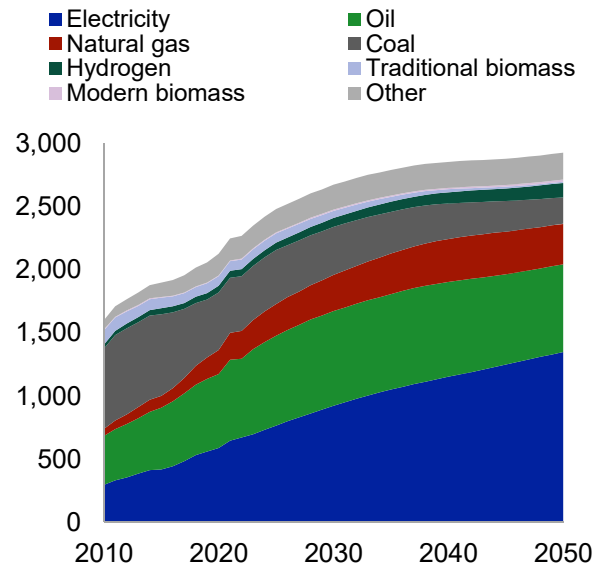


Volume CBAM covered CO2
2026-2040

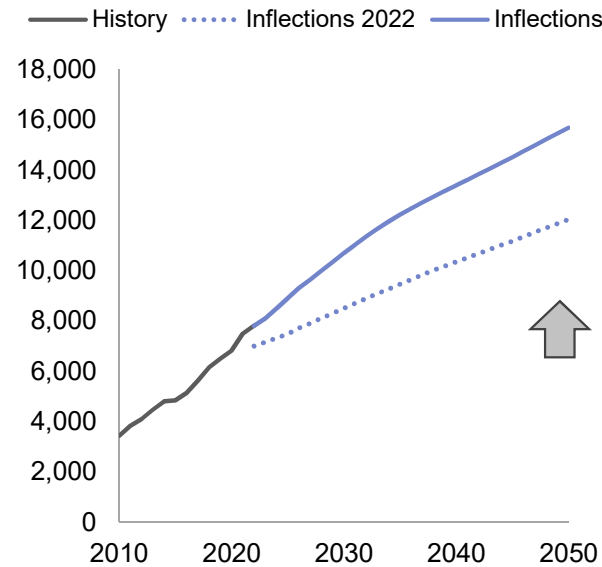


China is increasingly resembling a mature market, with slowing demand growth, accelerated electrification and rapid buildout of renewable power capacity

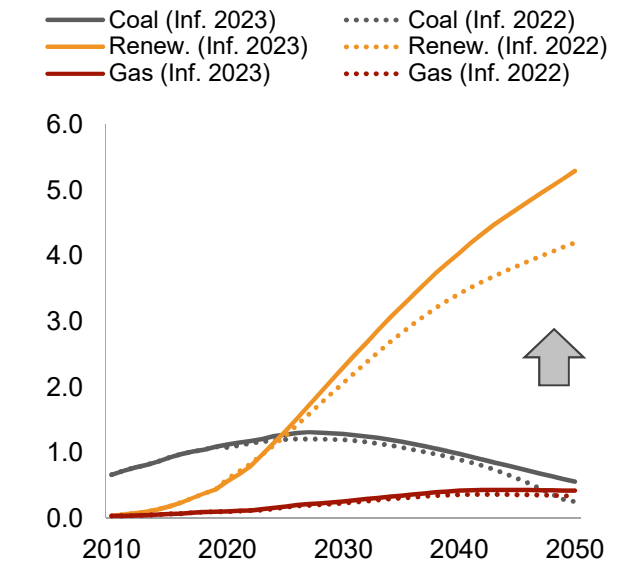
China final energy demand by fuel, Inflections scenario, (MMtoe)



China final electricity demand, (TWh)



China power capacity by key generating type, Inflections scenario, (TW)



Data compiled July 2023

1 Final energy consumption is energy supplied to final consumers for all energy uses. It is calculated by end-use sector and does not include energy losses from conversion or distribution.

2 Coal includes steam and coking coal.

3 Traditional biomass is used in the domestic sectors and includes charcoal, wood, and bagasse.

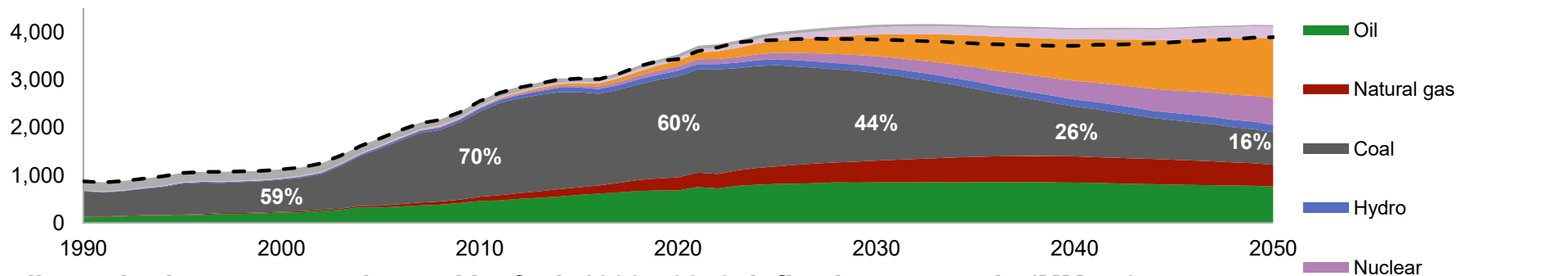
4 Modern biomass includes biofuels, biogas, biowaste, wood chips, and wood pellets.

5 Other includes district heat, small-scale nonelectric renewables (e.g., solar thermal water heating, heat pumps)

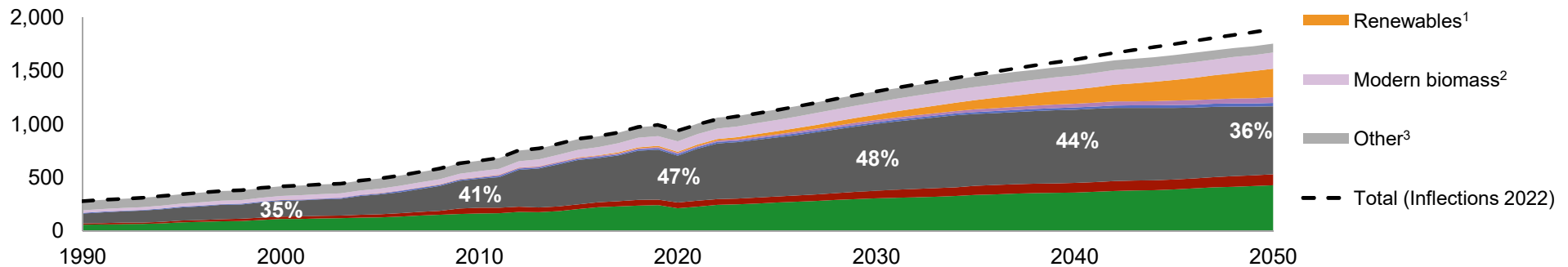
Source: S&P Global Commodity Insights

Diverging trends mean China will hit 'peak fossil' demand by 2025 in the Inflections scenario, but India grows its use of coal, gas and oil through 2050

China total primary energy demand by fuel, 1990 - 2050, Inflections scenario (MMtoe)



India total primary energy demand by fuel, 1990 - 2050, Inflections scenario (MMtoe)



Data compiled July 2023

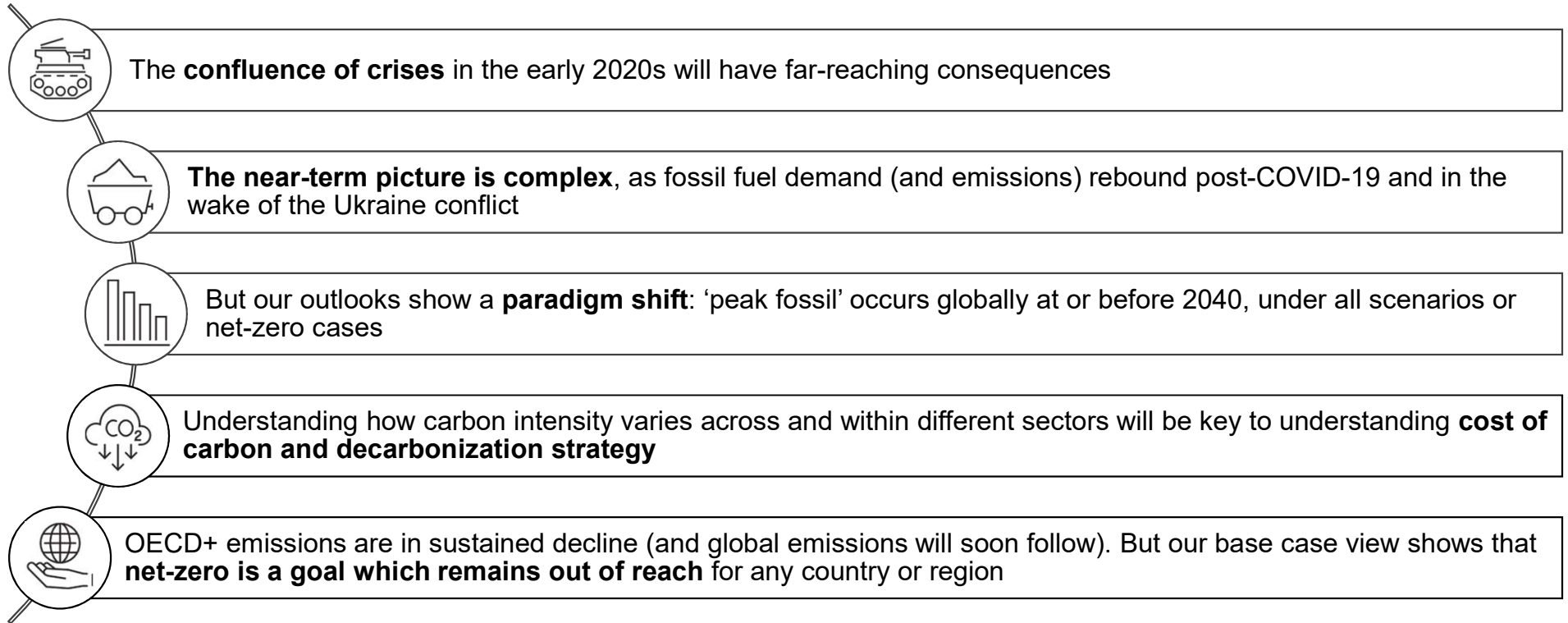
1 Includes solar, wind, geothermal, and ocean energy.

2 Includes biofuels and biomass (industry, electricity, district heat, and refining).

3 Includes solid waste, traditional biomass, ambient heat, net trade of electricity, or heat

Source: S&P Global Commodity Insights

Conclusion



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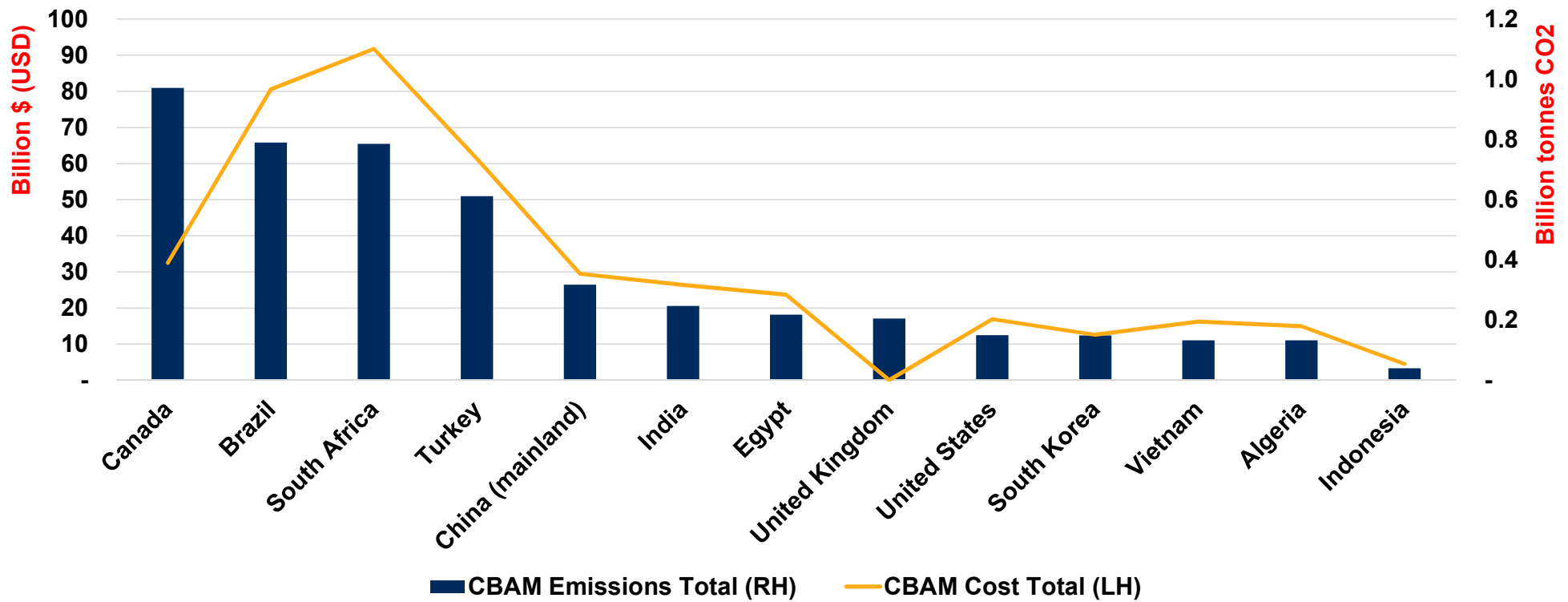
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Carbon pricing key towards reducing total EU CBAM liability; UK and Canada significantly reduce exposure owing to strong carbon prices

2026-2040 EU CBAM cost by country



Note: Carbon price forecasts converted into USD. Draft forecast valid December 2022, based on Inflections scenario of Energy and Climate Scenario modelling South Africa carbon price derived from forecast carbon tax level. India carbon price derived from assumptions over future cap and trade system. China ETS represents national ETS.

Agenda

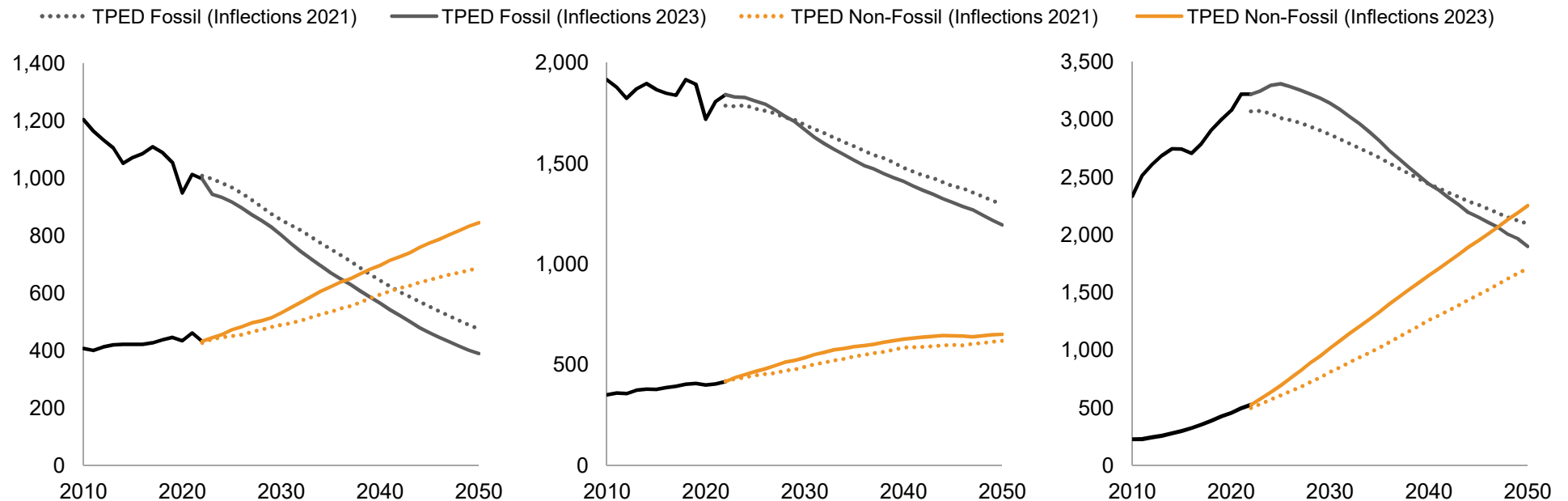
- **How has our view of the world changed since 2021?**
- **Is this a temporary blip, or a new era?**
- **What emerging trends will define the energy transition?**
- **What are the prospects for global decarbonization and the race to net-zero?**

The events of 2022 will have long-term impacts. Industrialised economies will see faster declines in demand for fossil fuels, and accelerated growth for renewables

EU Fossil & Non-Fossil demand 2010 - 2050, Inflections 2021 vs. Inflections 2023 (MMtoe)

US Fossil & Non-Fossil demand 2010 - 2050, Inflections 2021 vs. Inflections 2023 (MMtoe)




China Fossil & Non-Fossil demand 2010 - 2050, Inflections 2021 vs. Inflections 2023 (MMtoe)



As of September 2023
 Source: S&P Global Commodity Insights
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All outlooks illustrate some degree of energy transition. Compared to today's levels, fossil fuel demand and GHG emissions are lower in 2050 across the board

S&P Global Commodity Insights Energy and Climate Scenarios and Net-Zero cases: key metrics

| | | Global GDP (CAGR 2022–50) | 2050 TPED (change vs 2022) | 2050 Fossil fuel % of TPED | GHG emissions (change vs. 2022) | Global temperature (change by 2100) |
|---------------------------------------|---|------------------------------|-------------------------------|-------------------------------|------------------------------------|--|
| Inflections (base case) |  | 2.6% | +15% | 58% | -25% | 2.4°C |
| Green Rules |  | 2.4% | -6% | 39% | -59% | 1.7°C |
| Discord |  | 2.1% | +8% | 68% | -11% | 3.0°C |
| Net-Zero cases | | | | | | |
| Accelerated CCS (ACCS) | | 2.3% | -13% | 30% | -103% | 1.5°C |
| Multitech Mitigation (MTM) | | 2.3% | -20% | 20% | -101% | 1.5°C |

Data compiled July 2023

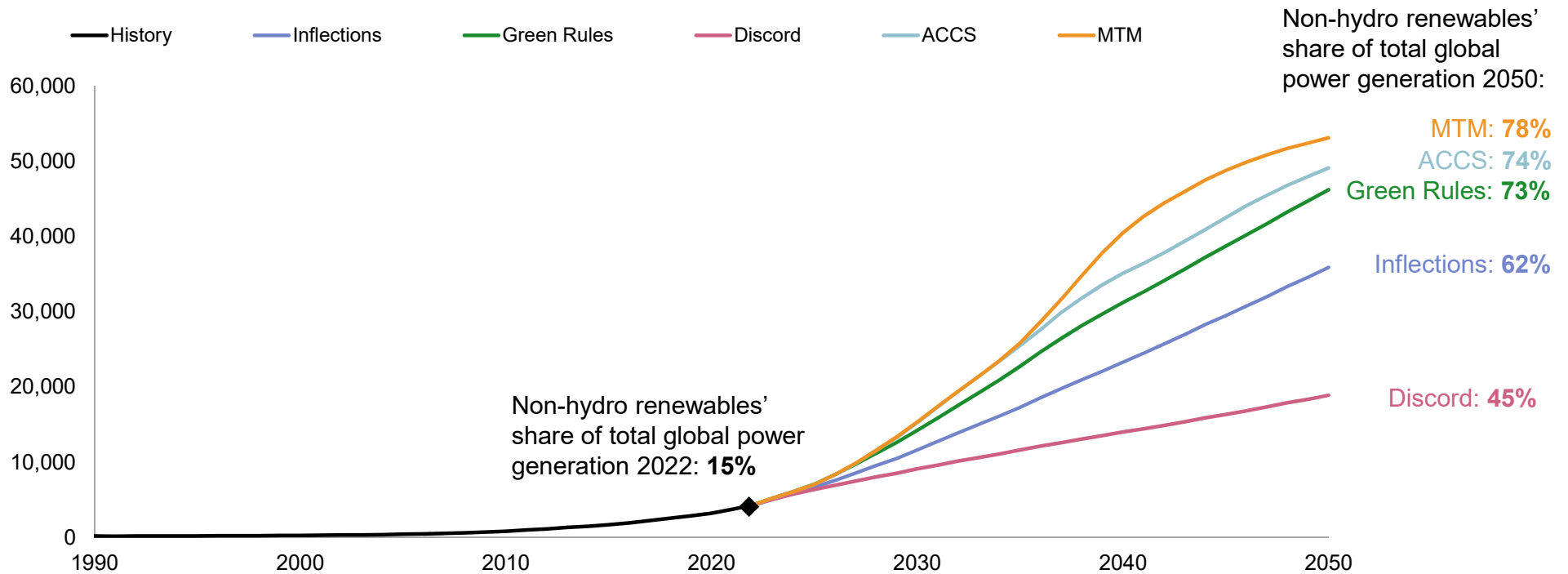
Note: Commodity Insights considers a country or region to have effectively reached "net-zero" emissions once GHG emissions have fallen to less than 1% of their 2022 level and remain at that level over the course of a year.

GHG = greenhouse gas; TPED = Total Primary Energy Demand

Source: S&P Global Commodity Insights

Renewable power output grows multi-fold under all outlooks & represents more than half of total global power generation by 2050 under the Inflections base case

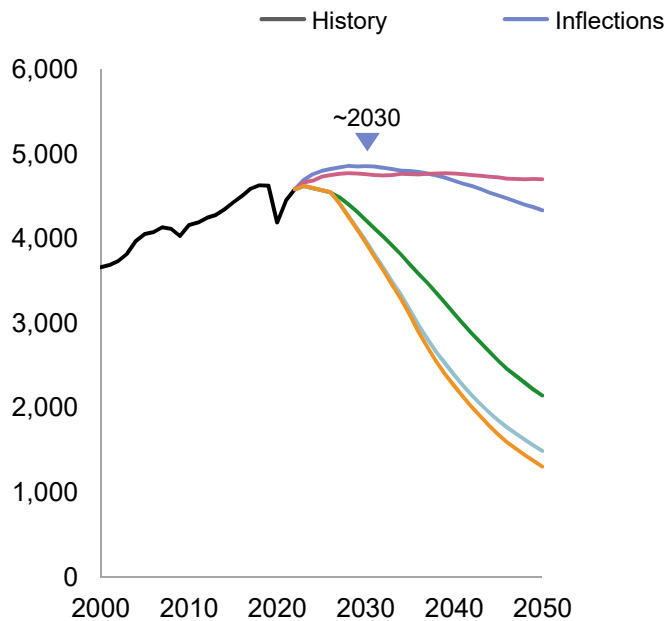
Global power generation by non-hydro renewable sources, 1990 - 2050 (TWh)



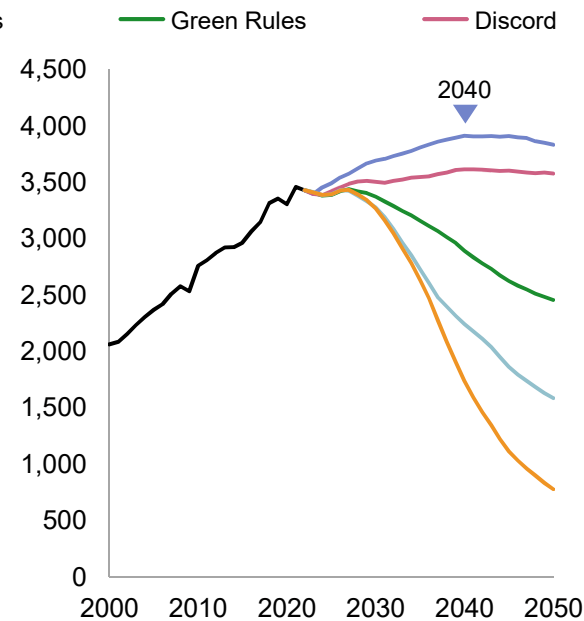
Data compiled July 2023
 Source: S&P Global Commodity Insights
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Our alternative scenarios reinforce this major paradigm shift: we no longer have a 'Business as Usual' view for long-term oil, gas and coal demand growth

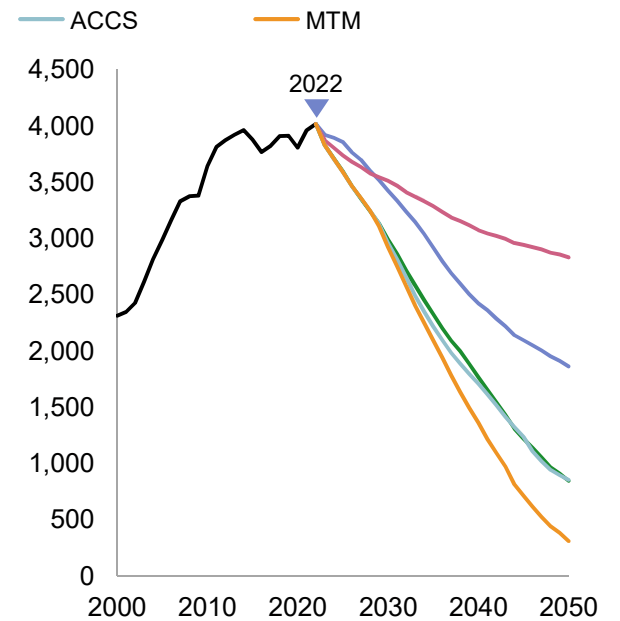
Global primary oil demand, 2000 - 2050 (MMtoe)



Global primary gas demand, 2000 - 2050 (MMtoe)



Global primary coal demand, 2000 - 2050 (MMtoe)

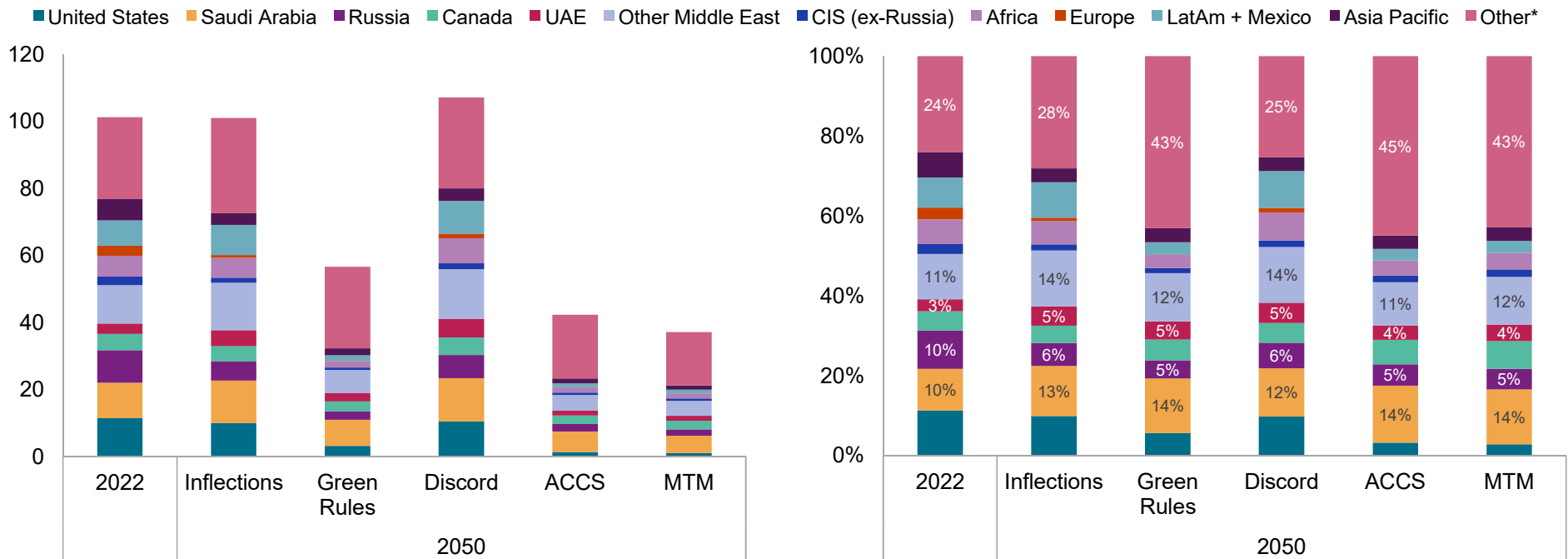


Data compiled September 2023
 ACCS = Accelerated CCS net-zero case
 MTM = Multitech Mitigation net-zero case
 Source: S&P Global Commodity Insights, Energy and Climate Scenarios
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Under the lower-demand scenarios key oil suppliers retain market share, but the growing role of biofuels is notable

Global oil (liquids) production 2022 & 2050 (million b/d)

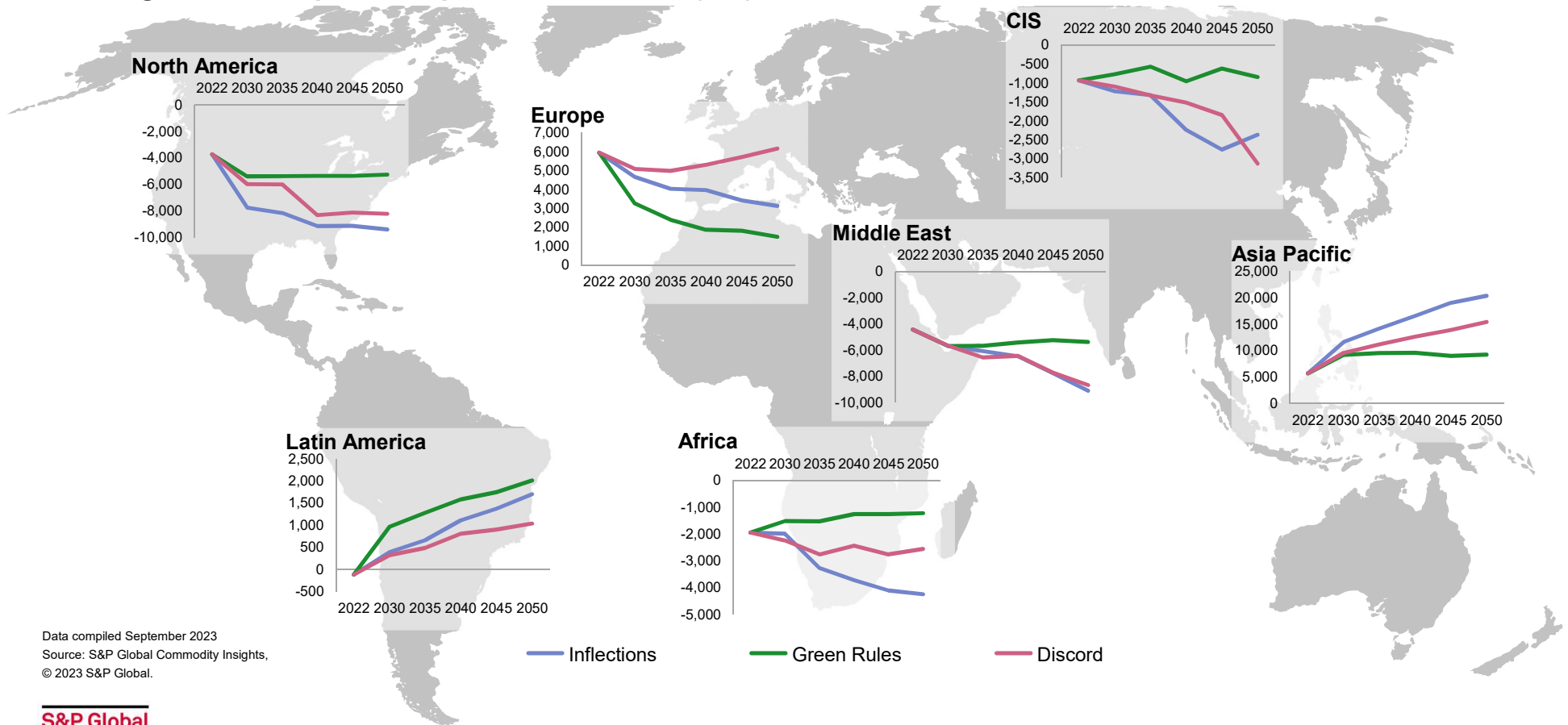
Global oil (liquids) production 2022 & 2050 (% of total)



* Includes condensate, NGLs, processing gains & biofuels
 Data compiled October 2023
 Source: S&P Global Commodity Insights
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Long-term LNG trends are nuanced, but import demand shifts increasingly to Asia Pacific regardless of outlook

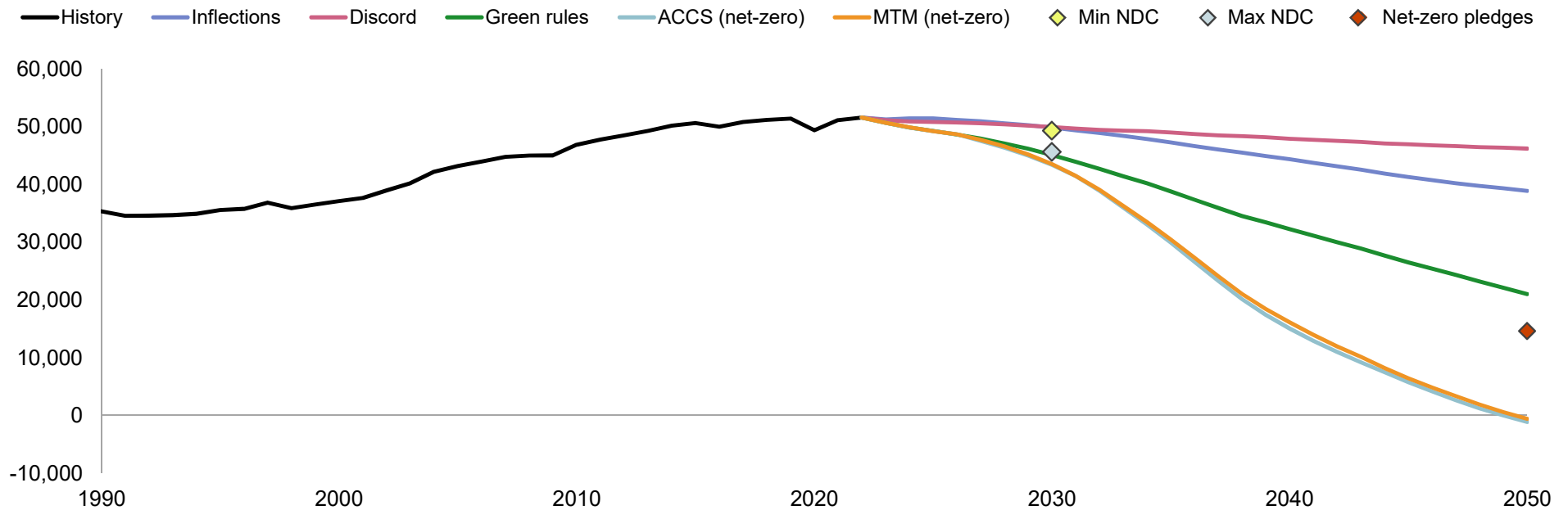
LNG regional net imports / exports, 2022 – 2050 (bcf)



Data compiled September 2023
 Source: S&P Global Commodity Insights,
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Heading into COP28, emission pledges made so far may or may not be adequate to meet the goals of the Paris Agreement

Total GHG emissions in S&P Global Commodity Insights global scenarios, parties' NDC targets, and net-zero pledges (MMtCO₂e)

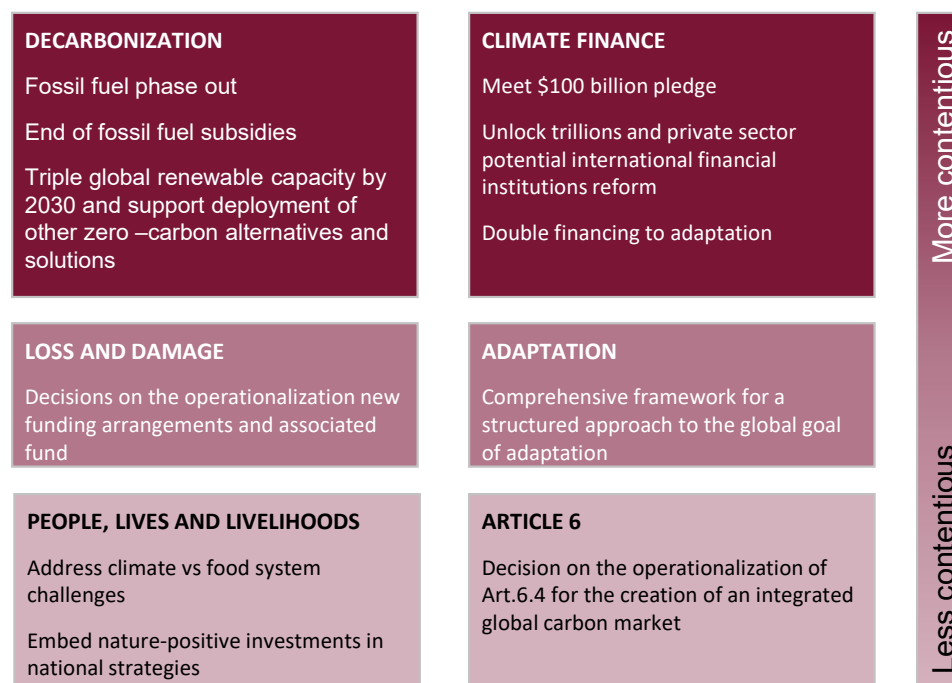


Data compiled October 2, 2023.
 Note: Assuming straight-line emissions reduction from 2030 NDC target to net-zero emissions in time frame targeted in pledge.
 Source: S&P Global Commodity Insights
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COP28: Parties called on to go ‘after gigatons’ and ‘activate a truly global response to the Global Stocktake (GST)’

- **COP28 has been presented as an inclusive and solution-driven summit.** Statements from the COP28 presidency highlight “keeping the 1.5 degree C goal alive” as the COP28 key priority, while maintaining an action-oriented vision.
- **At COP28, for the first time, Parties will be called on to assess progress on climate ambition action under the 1st Global Stocktake (GST).** The GST is a “moment of truth,” designed to catalyse further political commitment to fill current gaps and accelerate efforts in global climate ambition and action.
- **Cutting global GHG emissions over the next 7 years by about 43% (22 Gt) relative to present levels, as COP28 president-designate called for, is an incredibly ambitious and challenging goal.** At COP28, Parties will be inevitably called on addressing the sticking point of the phase out of fossil fuels along with the deployment of zero-carbon alternatives and the expansion of renewable energy.

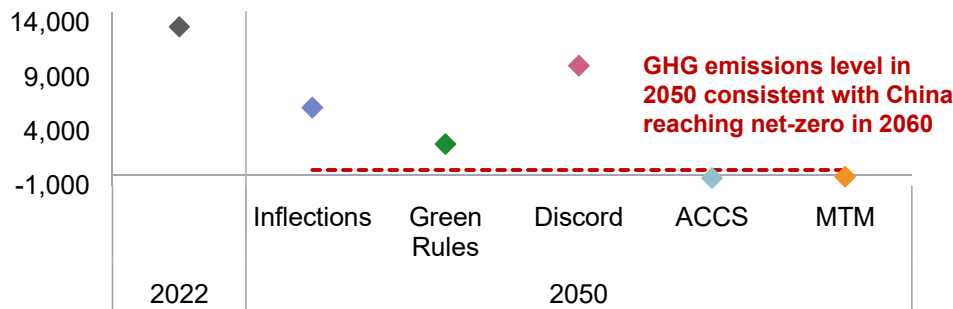
What to expect: COP28 agenda items and high-stake negotiating topics



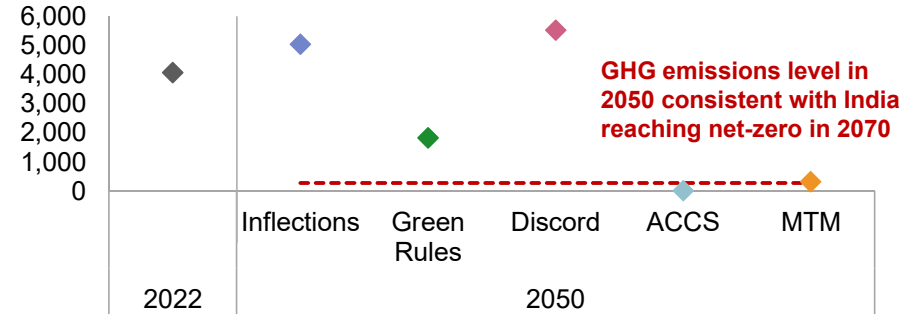
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But pledges may not be enough. Under the three core scenarios of Inflections, Green Rules and Discord, no market reaches or is on target for net-zero by 2050

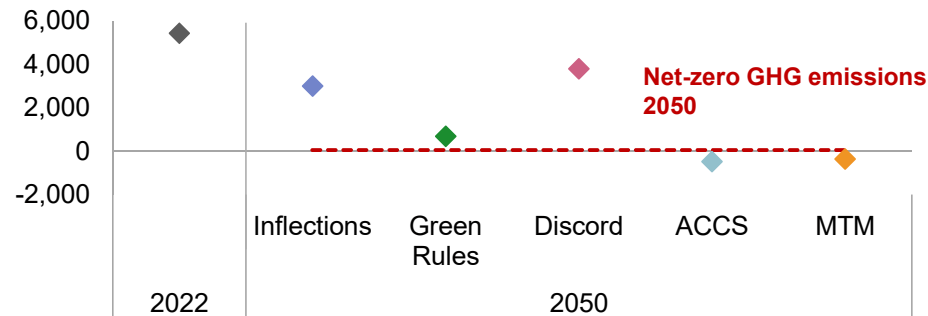
China GHG emissions, 2022 and 2050 (MtCO₂e)



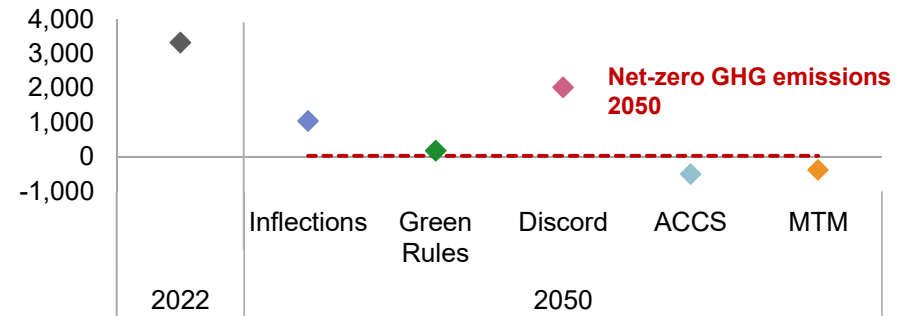
India GHG emissions, 2022 and 2050 (MtCO₂e)



US GHG emissions, 2022 and 2050 (MtCO₂e)



EU total GHG emissions, 2022 and 2050 (MtCO₂e)



Data compiled July 2023

Note: Commodity Insights considers a country or region to have effectively reached "net-zero" emissions once GHG emissions have fallen to less than 1% of their 2022 level and remain at that level over the course of a year.

Source: S&P Global Commodity Insights

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