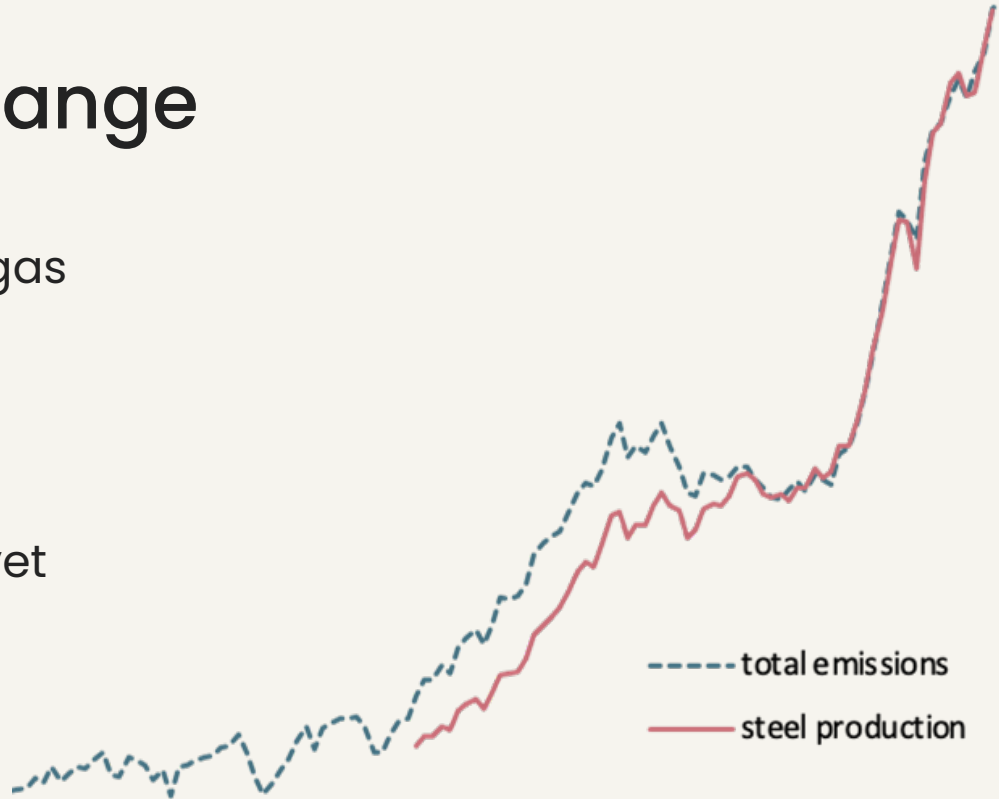


1.5 °C steel energy transitions

Dr. Valentin Vogl
Steel Industry Analyst, ARIA

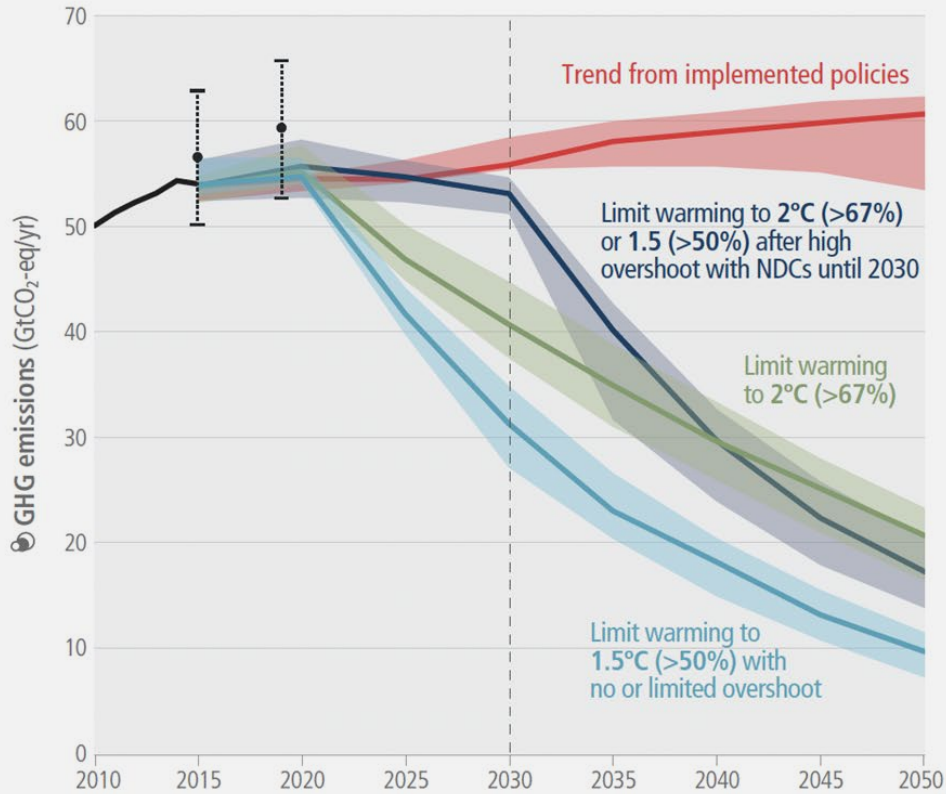
Steel & climate change

- 8% of global greenhouse gas emissions
- ~90% of which from coal
- Peak steel emissions not yet reached

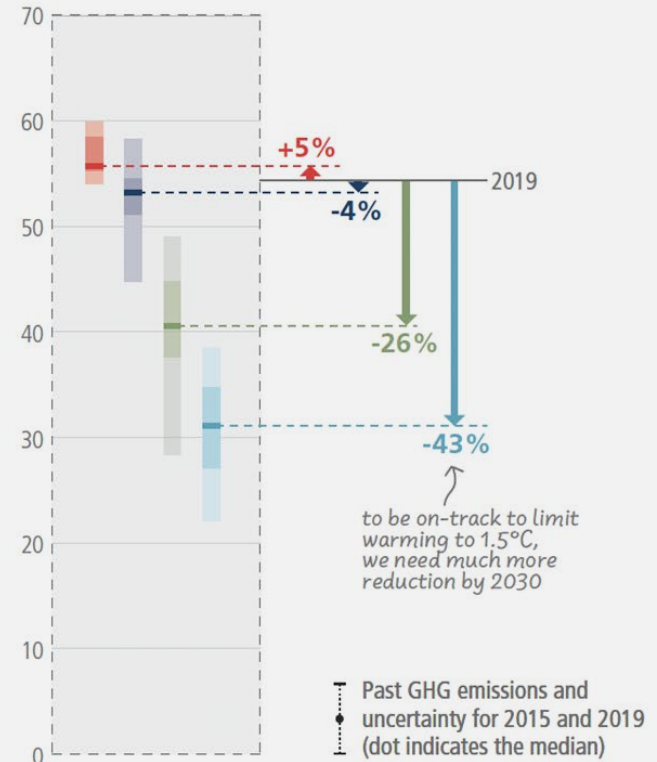


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a) Global GHG emissions



b) 2030



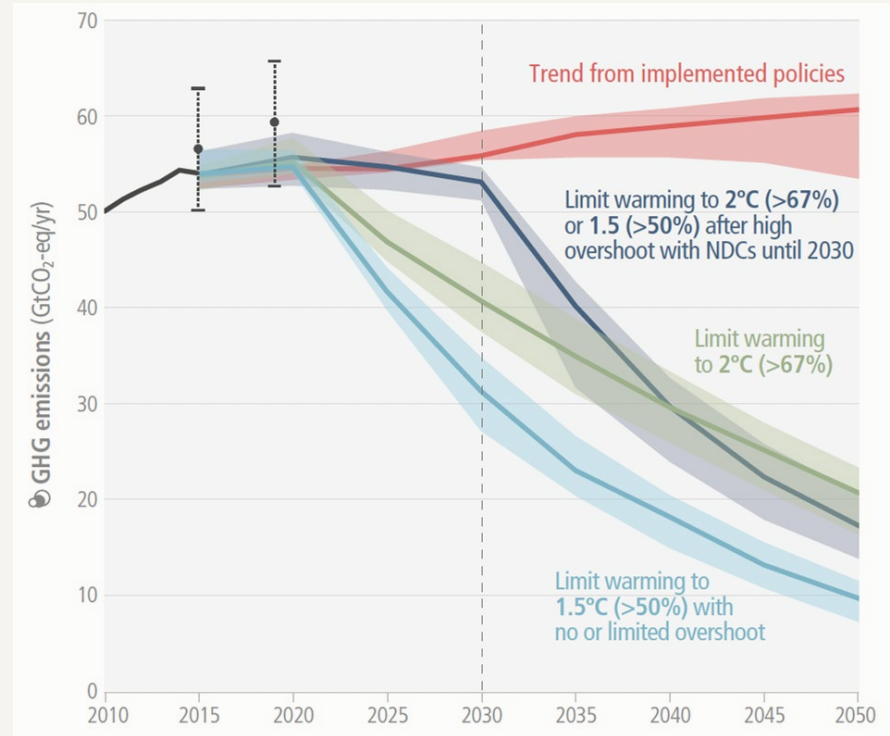
Decarbonisation timeline

50% chance to meet 1.5°C

- **-43%** by **2030** (v. 2019)
- -69% by 2040
- -82% by 2050

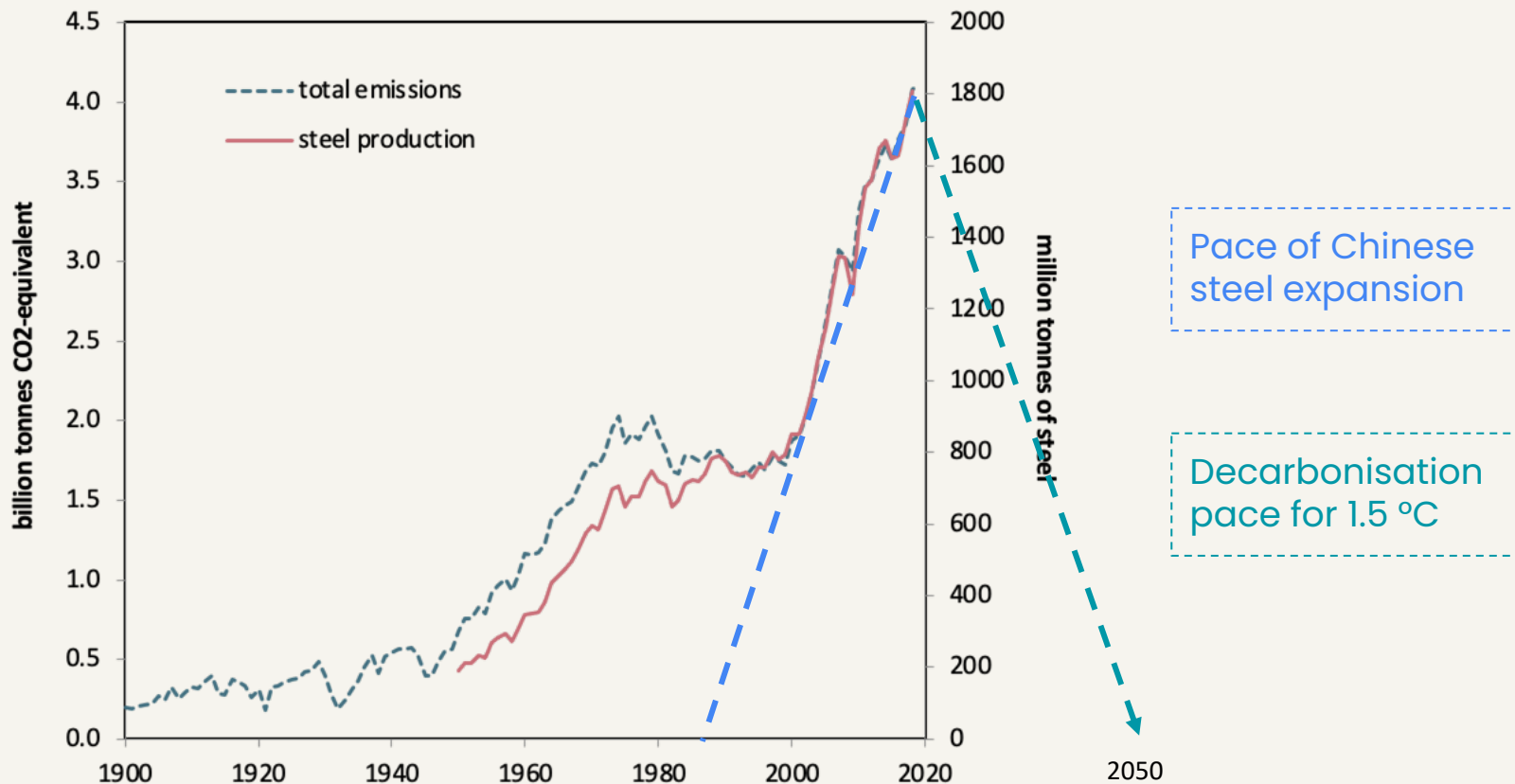
Key dynamics

- Sectoral interdependencies
- Responsibilities and capacities
- Leaders & laggards



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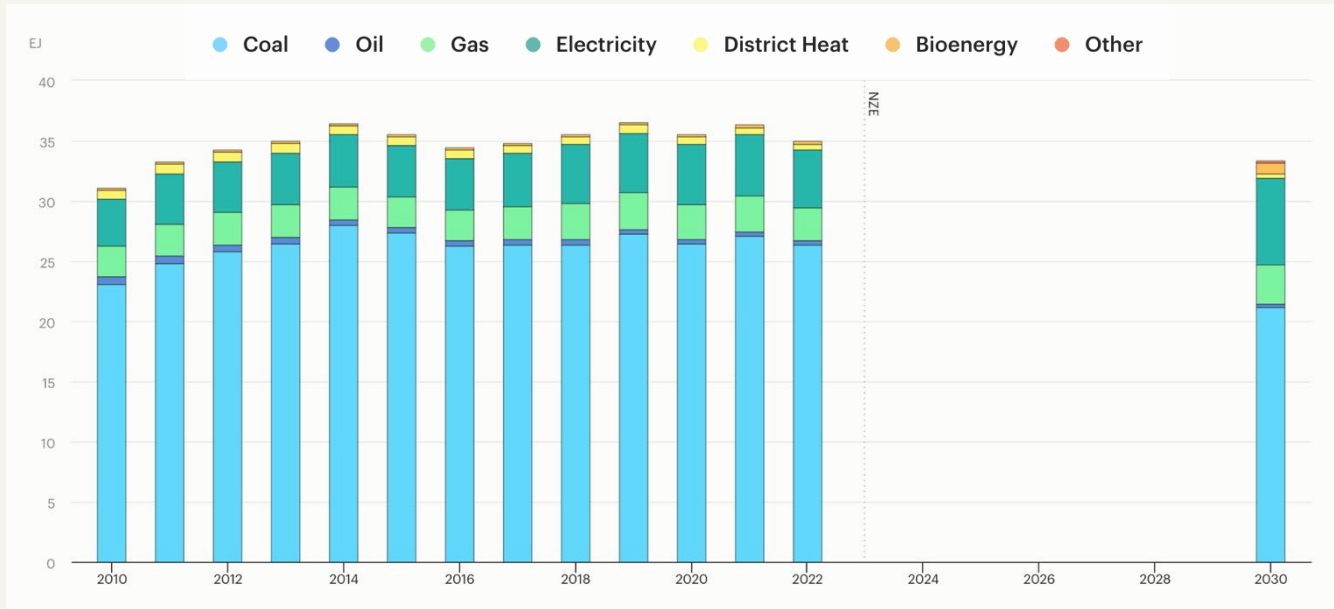
Mission steel decarbonisation



Steel decarbonisation as an energy transition

1. Steel is not the problem, fossil energy is
2. Transition in two overlapping phases:
 - Overcoming coal lock-in
 - Electrification and phasing in hydrogen
3. Energy transitions are fundamentally non-linear

Energy demand for iron and steel by fuel in the Net Zero Scenario, 2010–2030

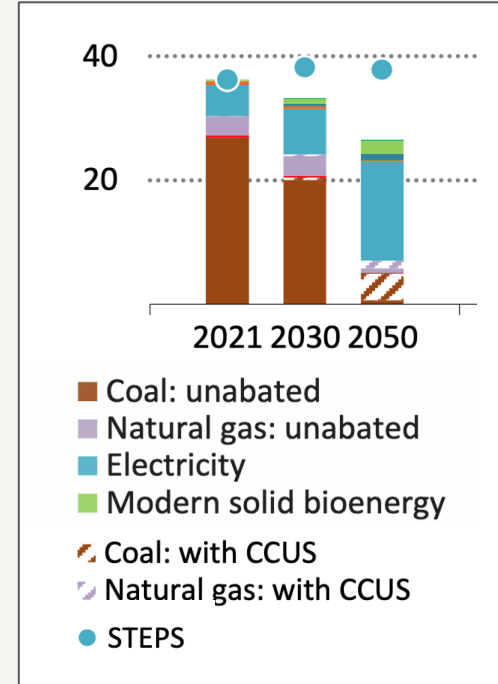


Source: IEA, Paris <https://www.iea.org/data-and-statistics/charts/energy-demand-for-iron-and-steel-by-fuel-in-the-net-zero-scenario-2010-2030-2>, IEA. Licence: CC BY 4.0

Energy options

- Hydrogen
- Direct electrification
- Biomass
- Fossil fuels + CCS

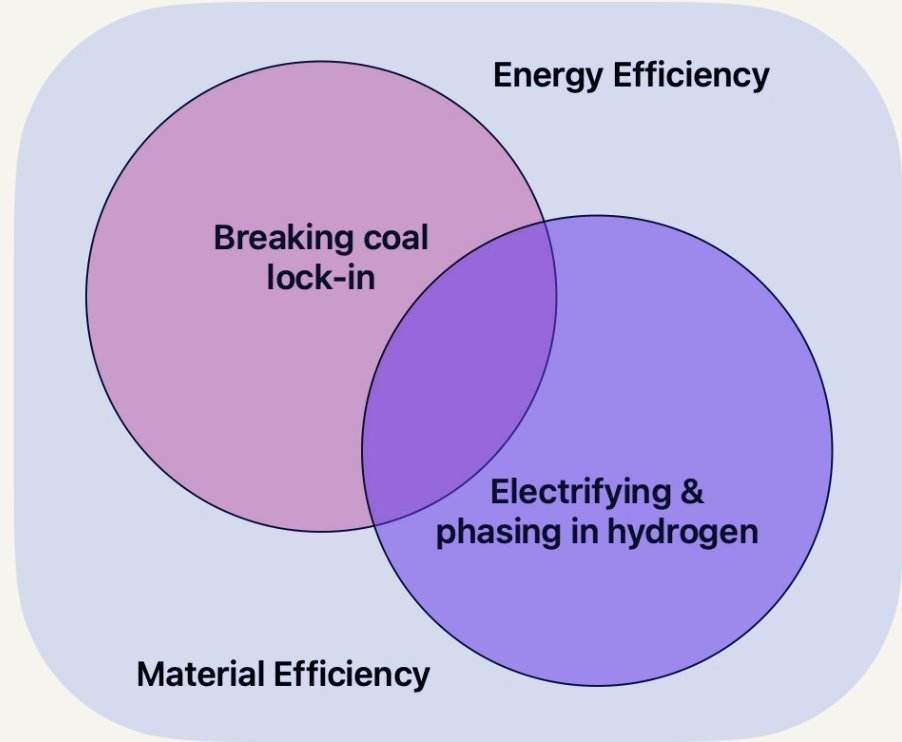
Final energy consumption, iron and steel, NZE



Source: IEA (2022), World Energy Outlook 2022, IEA, Paris
<https://www.iea.org/reports/world-energy-outlook-2022>, License: CC BY 4.0

A two-phased model for the steel energy transition

- Carbon lock-in
- The age of coal in steel is ending
- Power sector decarbonisation as key enabler



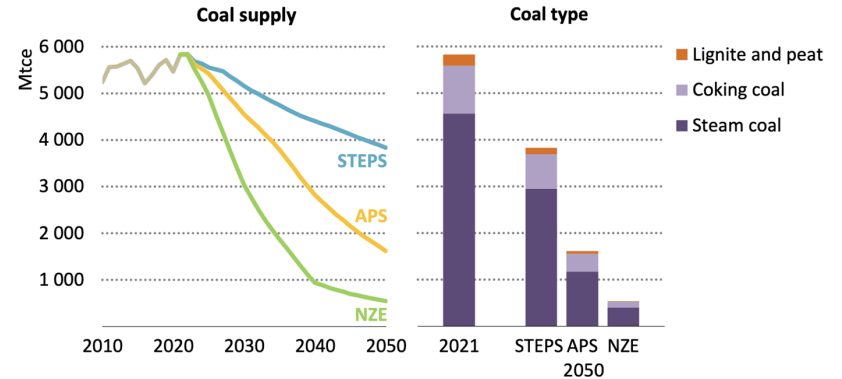
Blast from the past

- Decarbonising the BF would require a combination of
 - CCS with high capture rates...
 - ...on several exhaust pipes (incl. sinter/pellet, coal mine, lime kiln)
 - Long-term reliable CO₂ storage
 - Stable supply of low emission, sustainable biomass
 - Cost logic: CCS an added cost v. Large learning potential in electrification
- Large business risk of “blast furnace CCS” (stranded asset risk)

Phasing out coal

- Metallurgical coal so far sheltered from phase-out politics
- Thermal coal phase-out starting to spill over
 - Shared infrastructures
 - Divestment
 - Permitting
 - Pressure from civil society

Figure 9.5 ▶ Coal supply by scenario, 2010-2050

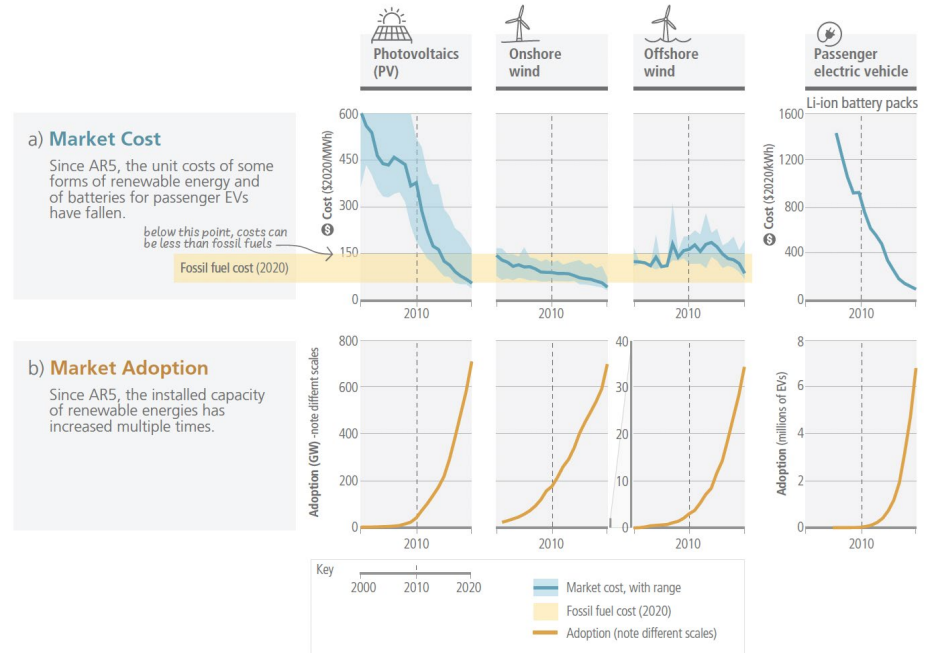


Source: IEA (2022), World Energy Outlook 2022, IEA, Paris
<https://www.iea.org/reports/world-energy-outlook-2022>,
License: CC BY 4.0

Leaping into renewables

- Renewables-based steelmaking already an option
 - Exciting start-ups
 - Green iron trade partnerships
 - “Green steel” has become a thing
- Gas-CCS a potential short-term option
- Plethora of new pathways emerging

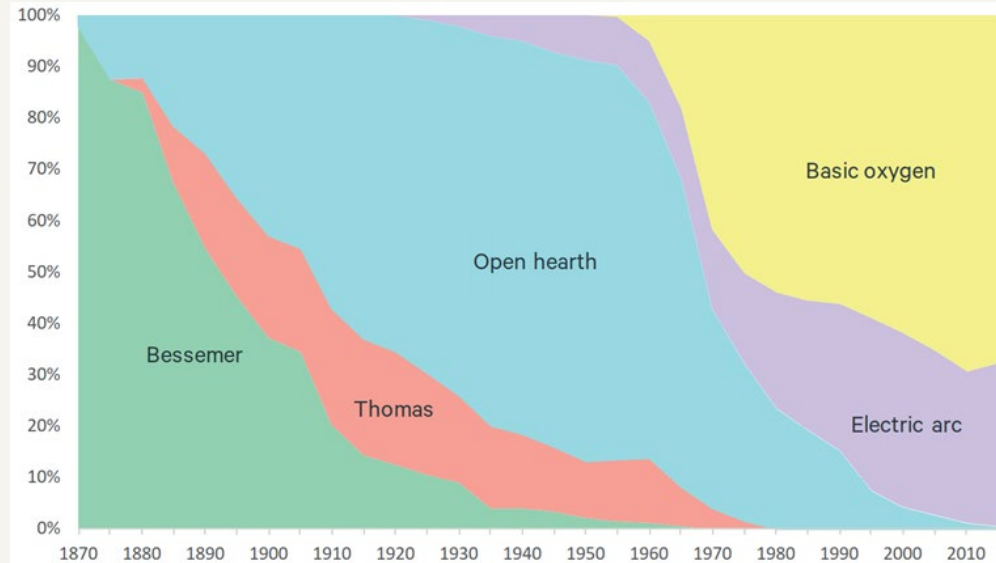
Renewable electricity generation is increasingly price-competitive and some sectors are electrifying



Source: IPCC, 2023. Climate Change 2023: Synthesis Report.
<https://www.ipcc.ch/report/ar6/syr/>

Conclusions

- 1.5 °C requires breaking carbon lock-in: **phasing out blast furnaces**
- Breaking lock-in opens wide range of pathways
- Non-linear transitions:
 - Tipping points
 - Economic restructuring
 - Fossil phase-out politics



Steelmaking technology diffusion rates

Source: Åhman et al. (2018) Hydrogen steelmaking for a low-carbon economy.
<https://www.sei.org/publications/hydrogen-steelmaking/>
Based on data by Worldsteel and Jernkontoret.

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**Thank you for
your attention**