



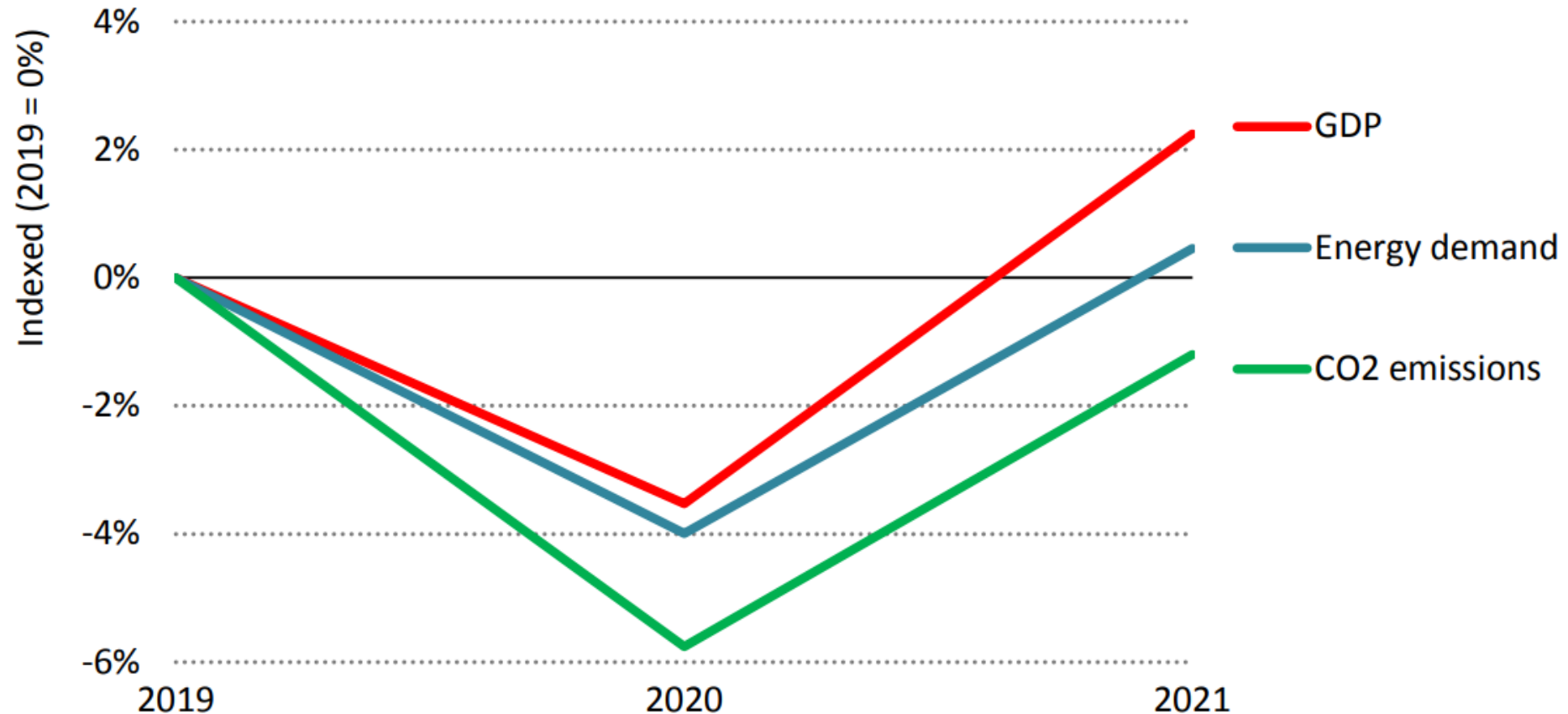
Energy consumption in high-energy industries and the path to carbon neutrality by 2050

Hugo Salamanca, Energy Efficiency Division, 2 December 2021

Biogas, Carbon Footprint and Industrial Symbiosis

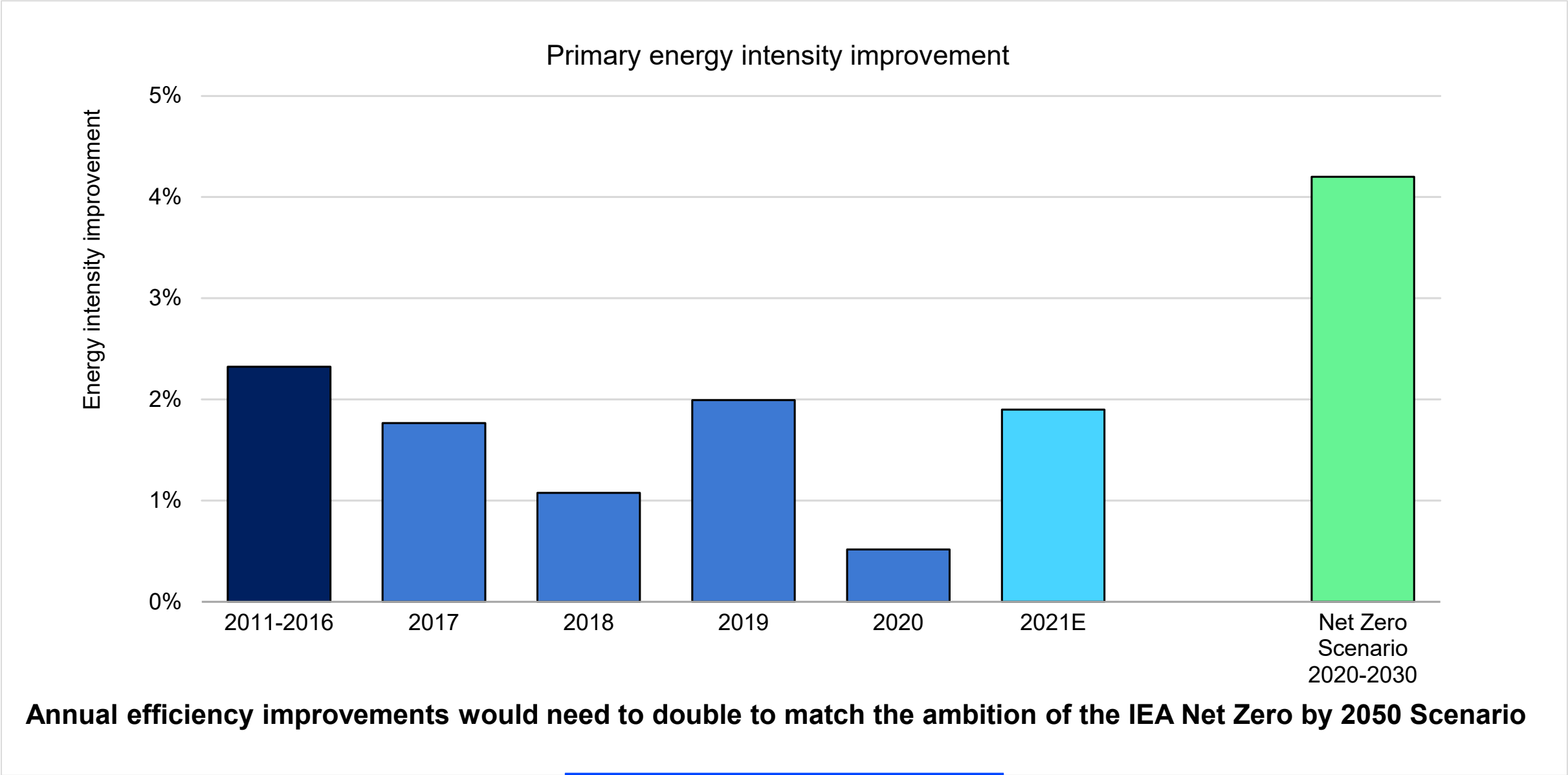
Global CO₂ emissions are on the rebound

Evolution of global GDP, total primary energy demand, and energy-related CO₂ emissions, relative to 2019

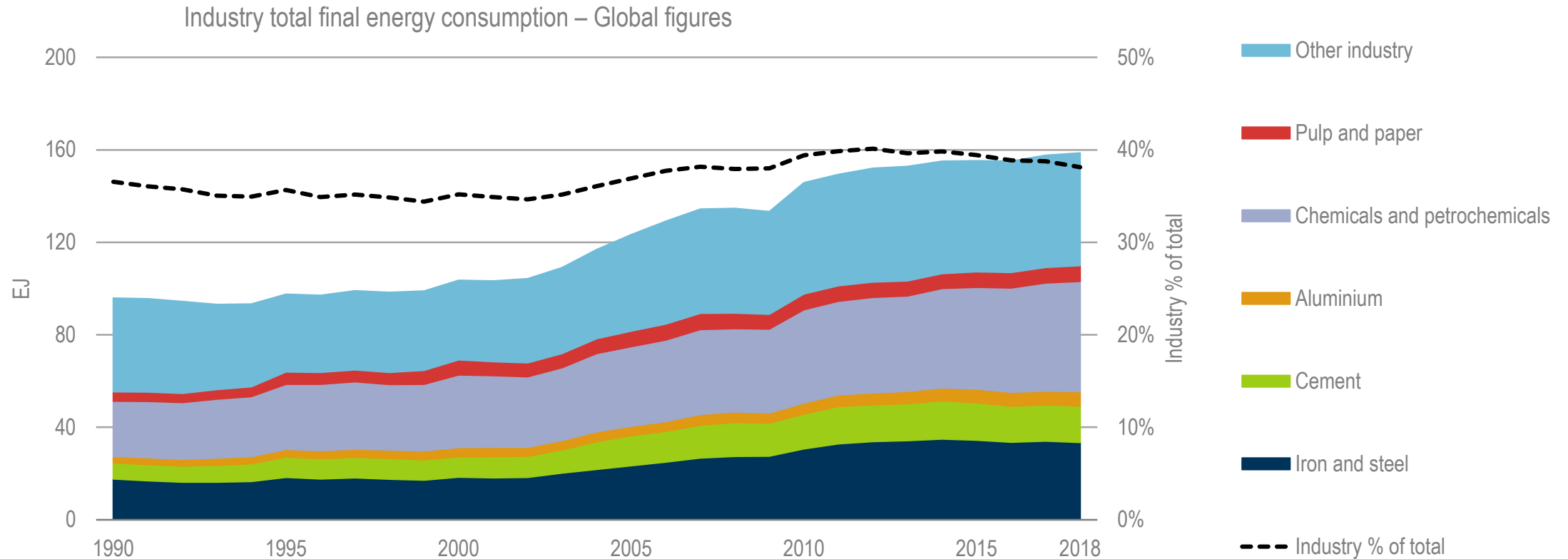


Global energy demand is set to increase by 4.6% in 2021, surpassing pre-Covid-19 levels.

Efficiency progress recovering after slowest year in a decade



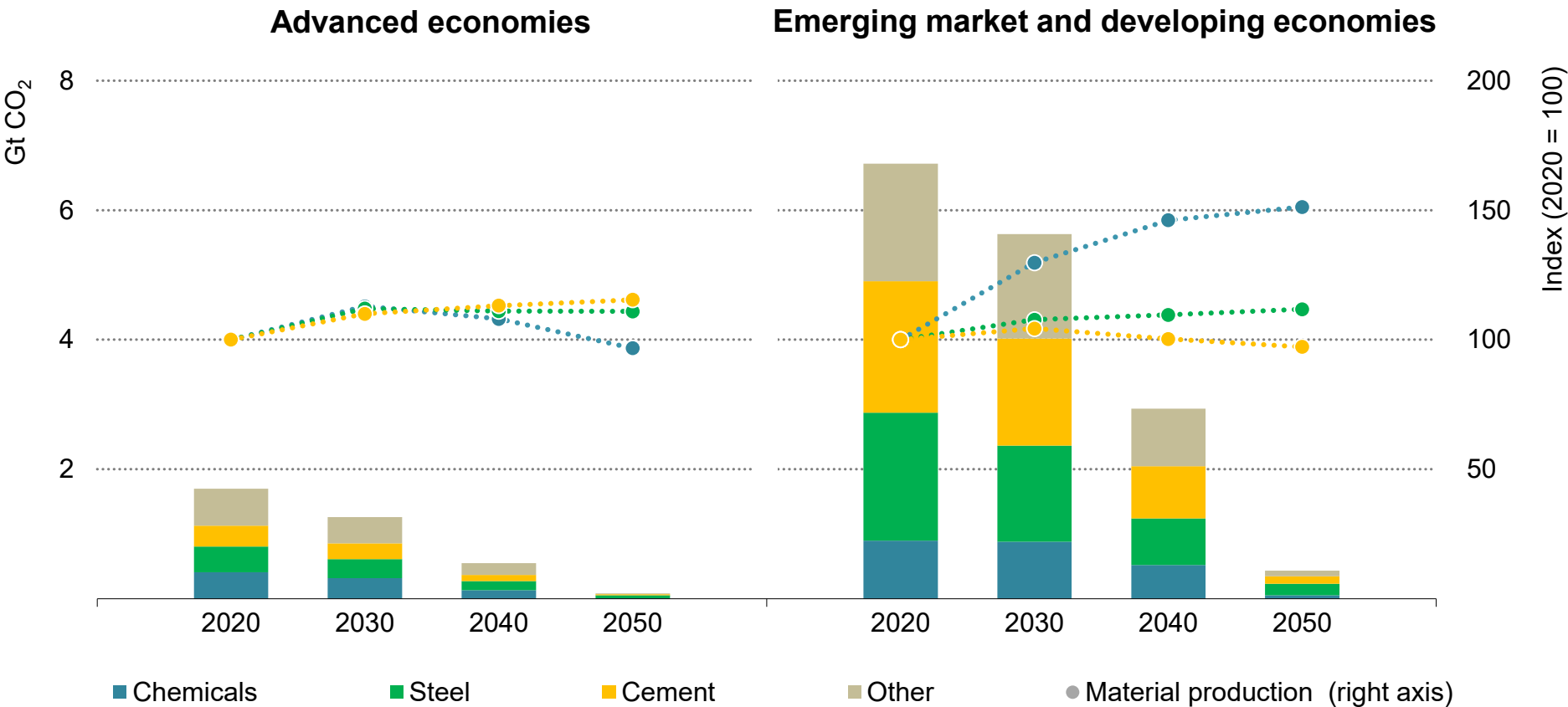
Industry contributes to a large share of global energy use



Globally, industry total energy use has grown more than one and a half times over the last 25 years driven by the doubling of energy use from the chemical and petrochemical and iron and steel sectors which represent more than 60% of that growth.

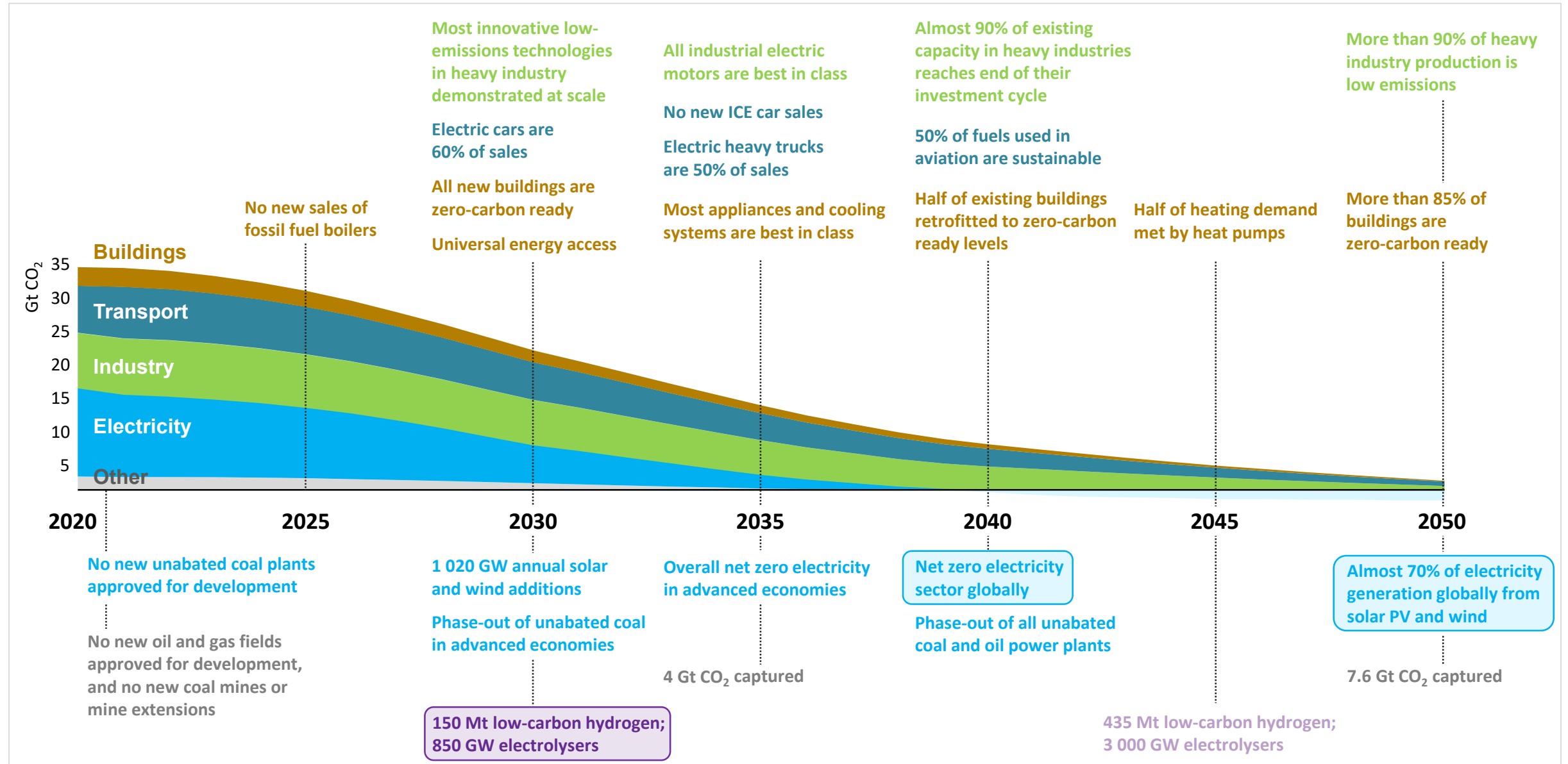
Dramatic reductions in industrial CO₂ emissions are required

Global CO₂ emissions from industry by sub-sector in the NZE



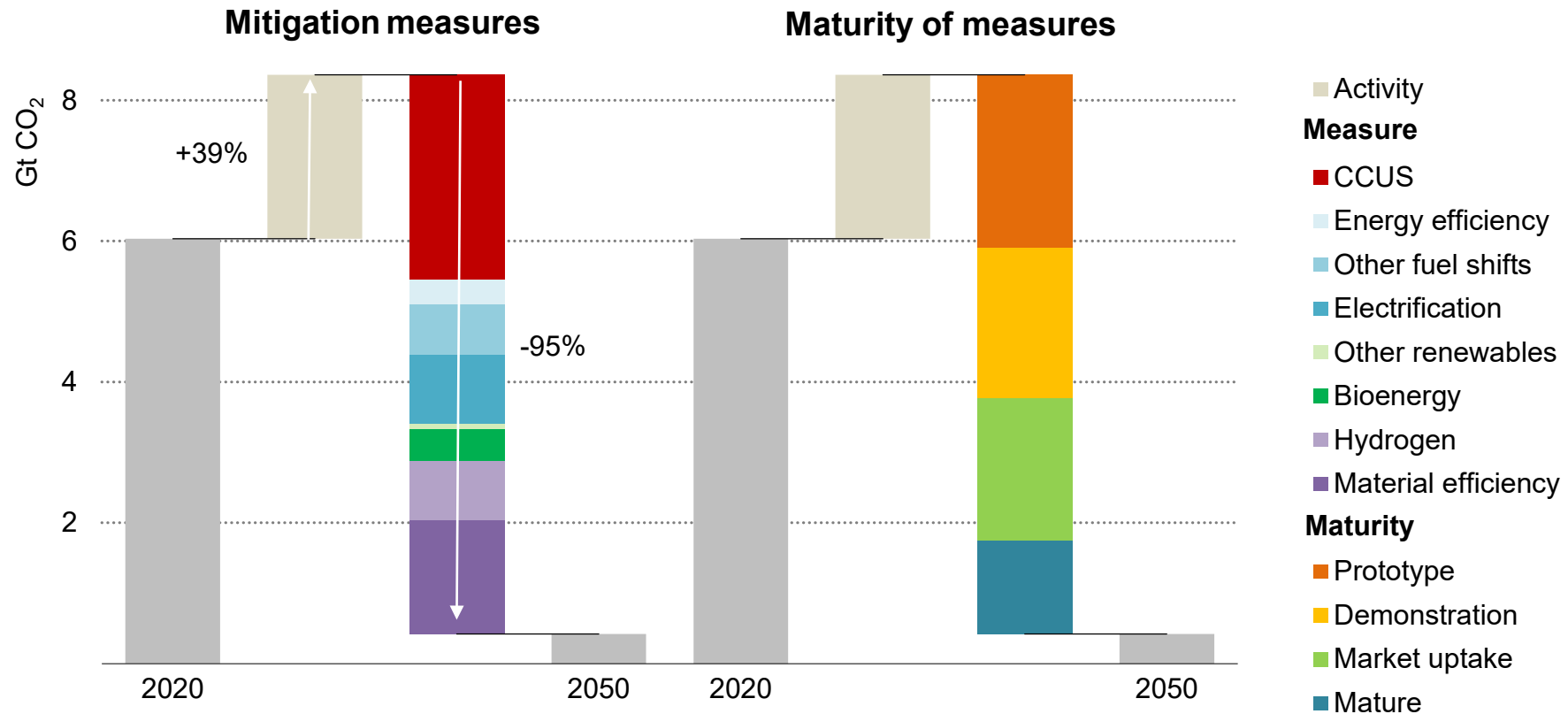
The majority of residual emissions in industry in 2050 come from heavy industries in emerging market and developing economies

Milestones on the path to Net Zero by 2050



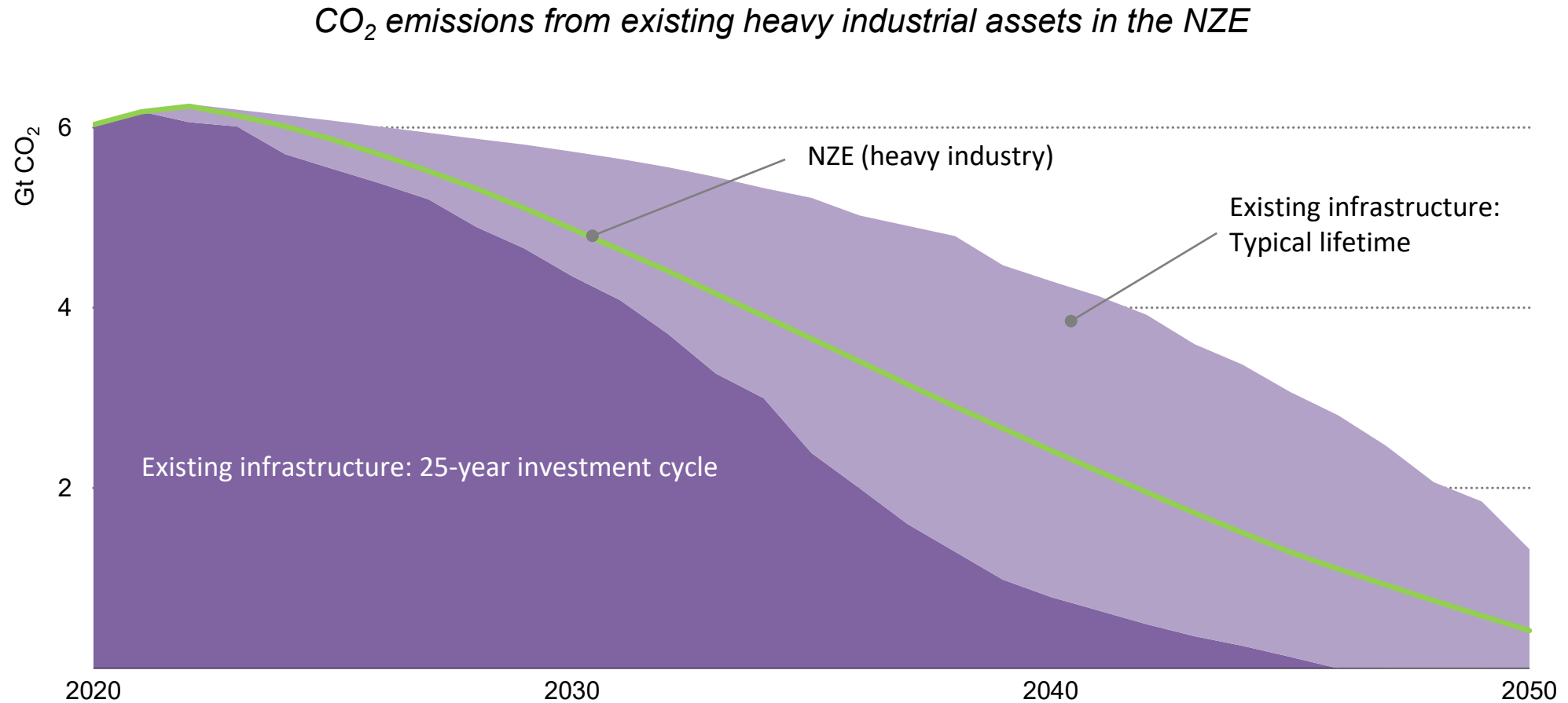
Addressing CO₂ emissions from heavy industry

Global CO₂ emissions reductions in heavy industry by mitigation measure and technology maturity category in the NZE



**An array of measures reduces emissions in heavy industry,
with innovative technologies like CCUS and hydrogen playing a critical role**

Addressing CO₂ emissions from heavy industry



Intervening at the end of the next 25-year investment cycle could help unlock 60 Gt CO₂, around 40% of projected emissions from existing heavy industry assets

Global partnerships to advance efficiency gains

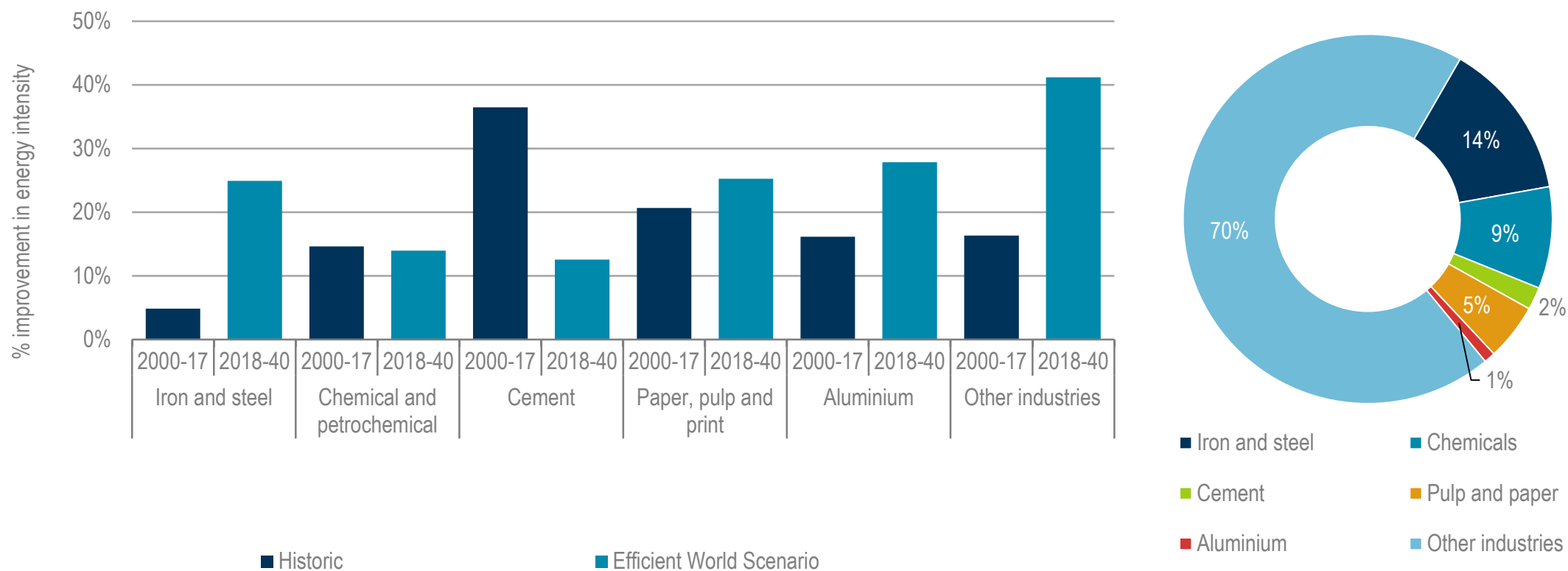
- At the request of Japan, the Agency benchmarked efficiency levels in G20 countries, focusing on key industrial sectors- iron, steel and cement.
- Our project report sets out key findings.
 - Untapped efficiency potentials are indicated in many G20 countries.
 - Stronger policy actions can help capture those potentials.
 - Further data can enhance global energy efficiency benchmarking
- Countries are already using the benchmarking approach to design and implement effective efficiency policies.

Driving Energy Efficiency in Heavy Industries

**Global energy efficiency
benchmarking in cement, iron &
steel**

Efficiency can improve across all industry sub-sectors

Percentage improvement in energy intensity by industry sub-sector (left) contribution to total energy savings in 2040 (right)



Energy efficiency improvements are possible across all sub-sectors.

Light industry (e.g. food beverage and textile manufacturing) represent the bulk (70%) of savings.

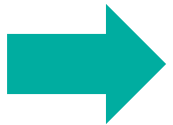
The ideal energy efficiency policy packages

Regulations

Information

Incentives

- The IEA is currently working to develop specific work in the pulp and Paper sector. Main work streams consist in :
 - Developing key indicators:
 - Specific thermal energy by tonne of pulp
 - Specific electric energy by tonne of paper
 - Benchmarking against BAT and international best practices
 - Indicators to measure auto production of electricity (use of black liquor)
 - Reuse of paper to reduce energy intensity
 - What are the main opportunities for energy efficiency and what policies could be developed to unlock them



Data availability is still a main limiting factor. A key area of progress is to encourage global partnership between governments and the industry to share data and best practices.

- The ETP Clean Energy Technology Guide is an interactive framework that contains information for over 400 individual technology designs and components across the whole energy system that contribute to achieving the goal of net-zero emissions.
- For each of these technologies, it includes information on the level of maturity (or Technology Readiness Level, TRL) and a compilation of development and deployment plans, as well as cost and performance improvement targets and leading players in the field.

Readiness level (TRL) ?	Sector	Technology	Step in value chain	Importance for net-zero emissions
3	Industry > Chemicals and plastics	Production > Fossil- or biomass-based > Steam cracker electrification	Production	<div>Technology Readiness Levels (TRLs)</div> <div><div>Concept</div><div>1Initial idea Basic principles have been defined</div><div>2Application formulated Concept and application of solution have been formulated</div><div>3Concept needs validation Solution needs to be prototyped and applied</div></div> <div><div>Small prototype</div><div>4Early prototype Prototype proven in test conditions</div><div>Beyond the SDS ↑</div></div> <div><div>Large prototype</div><div>5Large prototype Components proven in conditions to be deployed</div><div>6Full prototype at scale Prototype proven at scale in conditions to be deployed</div><div>Scope of the SDS ↓</div></div> <div><div>Demonstration</div><div>7Pre-commercial demonstration Prototype working in expected conditions</div><div>8First of a kind commercial Commercial demonstration, full-scale deployment in final conditions</div></div> <div><div>Early adoption</div><div>9Commercial operation in relevant environment Solution is commercially available, needs evolutionary improvement to stay competitive</div><div>10Integration needed at scale Solution is commercial and competitive but needs further integration efforts</div></div> <div><div>Mature</div><div>11Proof of stability reached Predictable growth</div></div>
5	Industry > Chemicals and plastics	Production > Biomass-based > Bioethanol route > Lignocellulosic gasification	Production	
5	Industry > Chemicals and plastics	Production > Fossil or biomass-based > CCUS > Physical adsorption	Production	
6	Industry > Chemicals and plastics	Production > Biomass-based > Lignin	Production	
6	Industry > Chemicals and plastics	Production > Fossil-based > Methane pyrolysis	Production	
6	Industry > Chemicals and plastics	Production > Biomass-based > Gasification	Production	
7	Industry > Chemicals and plastics	New recycling techniques with reduced downcycling > Hydrothermal upgrading	End-of-life	
7	Industry > Chemicals and plastics	New recycling techniques with reduced downcycling > Solvent dissolution for PET	End-of-life	
7	Industry > Chemicals and plastics	Production > Fossil- or biomass-based > CCUS > Physical absorption	Production	

Physical absorption uses a liquid solvent to absorb CO2 from flue gases that have high CO2 partial pressures, without a chemical reaction solvents include Selexol (dimethyl ethers of polyethylene glycol) and Rectisol (methanol).

Cross-cutting themes: [Materials](#), [CCUS](#), [CO2 removal](#)

Key countries: [China](#)

Key initiatives:

- Yanchang Petroleum built a capture plant at the Yulin coal-to-chemical plant (50 kt CO2/yr) and later began building a large-scale u plant in Jingbian. The projects use Rectisol acid gas removal and the CO2 is stored through use for enhanced oil recovery.

<https://www.iea.org/articles/etp-clean-energy-technology-guide>

Exploring key “spots” in global energy

Recent publications



The IEA is shining a light on the major areas of the energy system that need to be combined to ensure a clean transition, with considerable focus on the industry sector.

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