Enerdata
intelligence + consulting

23 Nov. 2023

2015-2022 : ANALYSE DU *GLOBAL STOCKTAKE*
2023-2030-2050 : ET MAINTENANT, QUELLE TRAJECTOIRE

Pascal CHARRIAU, Enerdata

Introduction – notre analyse du *Global Stocktake*

- *Global Stocktake* (bilan ou inventaire mondial) : étape formelle prévue à l'accord de Paris visant à **évaluer la mise en œuvre des progrès collectifs**
- Approche mondiale, **ne permettant pas une évaluation plus fine à l'échelle des pays et des secteurs**
- Notre contribution : **s'approprier et décliner l'analyse de manière régionale et sectorielle**
  - Identifier les drivers principaux derrière l'évolution des émissions
  - Mettre les résultats en perspective avec nos scénarios de long terme (EnerFuture)
- Identité de Kaya: $$Emissions\ de\ CO_2 = Population * \underbrace{\frac{GDP}{Population}}_{\text{PIB/tête}} * \underbrace{\frac{Consommation\ d'énergie}{GDP}}_{\text{Intensité énergétique}} * \underbrace{\frac{Emissions\ de\ CO_2}{Consommation\ d'énergie}}_{\text{Facteur carbone}}$$
- *Webinaire avec l'analyse complète **jeudi 30 novembre à 11h***

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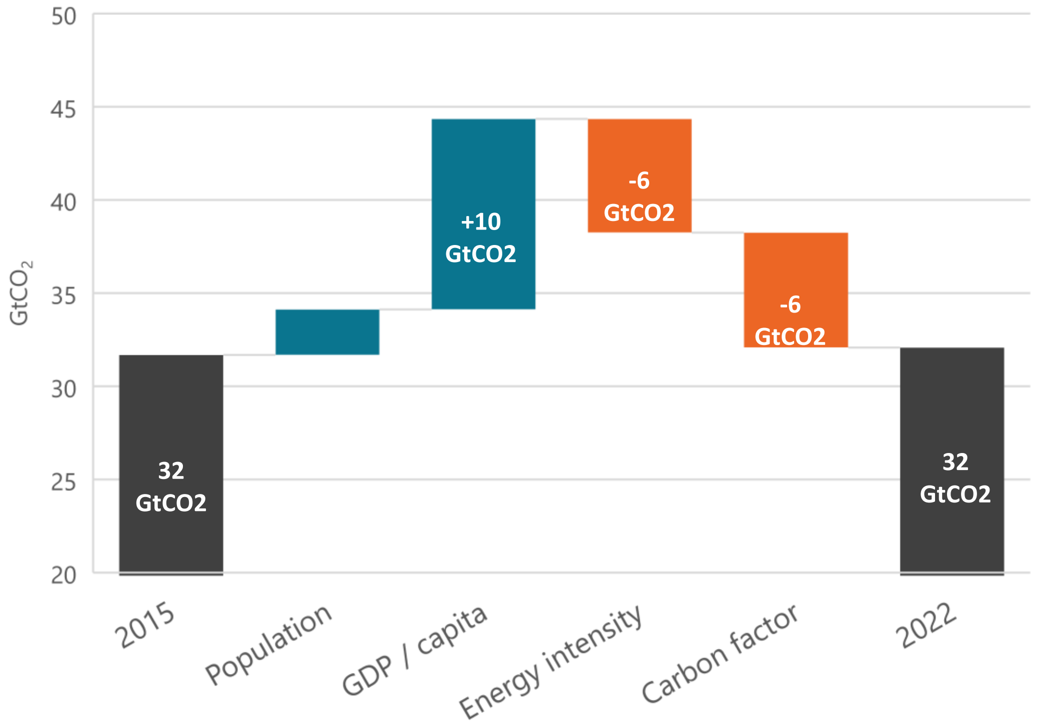
Flashback 2015 - Quelle trajectoire pour tenir les objectifs de la COP21 ?

Les émissions mondiales de CO_2 doivent atteindre un plateau en 2025 au plus tard

- Un **développement** économique, démographique et des niveaux de vie qui **tire la consommation d'énergie à la hausse**
- L'impact de cette hausse d'activité sur la consommation énergétique est **atténué** principalement par des **gains d'efficacité**
- L'**énergie** est **progressivement décarbonée**
  - Par le poids croissant des **énergies renouvelables**
  - Par des substitutions entre fossiles (**sortie progressive du charbon** au bénéfice du gaz naturel)
- La baisse de l'*intensité énergétique* et du *facteur carbone* permet de compenser l'activité et de stabiliser les émissions de CO_2

EVOLUTION ATTENDUE DES EMISSIONS MONDIALES CO_2 ENERGIE (2015-2022)

DECOMPOSITION PAR LEVIER (KAYA)



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2023 - Les émissions de CO_2 ont augmenté

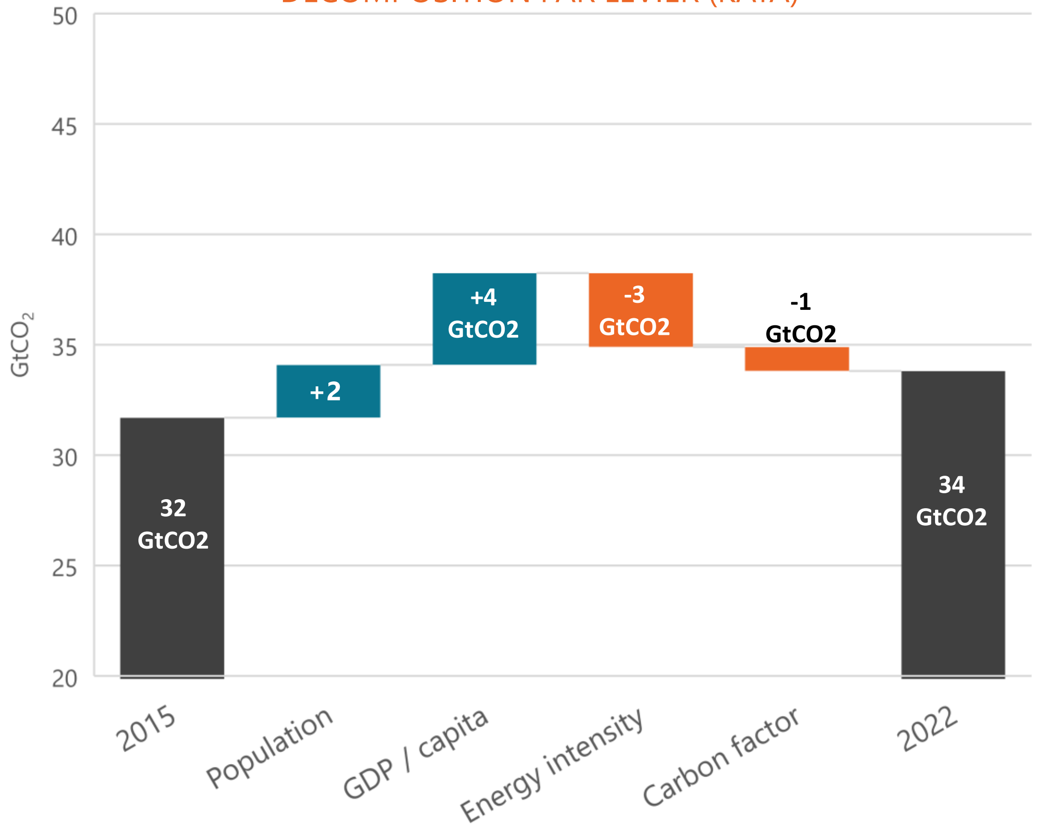
malgré une croissance du PIB mondial plus faible que prévue

La baisse de l'intensité énergétique et du facteur carbone n'est pas en ligne avec l'objectif de < 2°C

- **Croissance économique inférieure à celle attendue** (+20% vs 30% prévus entre 2015 et 2022)
- La **consommation d'énergie mondiale a augmenté de 10%** depuis 2015
- Le **facteur carbone a très peu diminué**
  - Forte hausse des investissements dans les **énergies renouvelables** et accélération de **l'électrification** *dans certains usages*
  - **Croissance en volume des énergies fossiles** – toujours très majoritaires (80% en 2022 vs. 82% en 2015)
- Les **émissions de CO_2 ont donc continué de croitre** (+7% entre 2015 et 2022)

EVOLUTION REELLE DES EMISSIONS MONDIALES DE CO_2 ENERGIE (2015-2022)

DECOMPOSITION PAR LEVIER (KAYA)



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November 2023

WHAT STEPS TO REACH THE 2050 ENERGY-CLIMATE GOALS?

An In-Depth Look at the Future of Energy

Powered by our EnerFuture scenarios derived from the POLES-Enerdata model

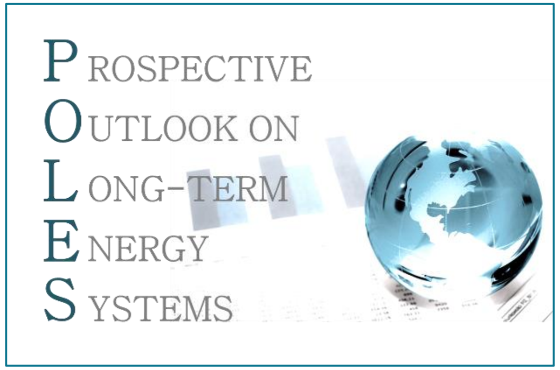
Scenario definition
Three energy-climate scenarios to explore possible futures of global energy systems

- Enerdata has prepared **three contrasted energy-climate scenarios** up to 2050 to explore **possible pathways for the global energy sector**

EnerBase	EnerBlue	EnerGreen
Continuation of existing policies and trends *Temperature increase above 3°C*	**Achievement of new NDCs submitted up to end of 2022** *Temperature increase around 2.5°C*	**Ambitious GHG emissions budget in line with the Paris Agreement** *Temperature increase well below 2°C*

- EnerFuture is relying on the recognised **POLES-Enerdata model:**
  - energy-economy-environment model
  - global coverage, with 66 countries and regions
  - dedicating modelling of: final demand sectors, energy supply, prices and GHG emissions
  - time horizon: 2050

Note: The POLES model has been initially developed by IEPE (Institute for Economics and Energy Policy), now GAEL lab (Grenoble Applied Economics Lab)



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Key indicators

Main results from our 3 scenarios at a glance

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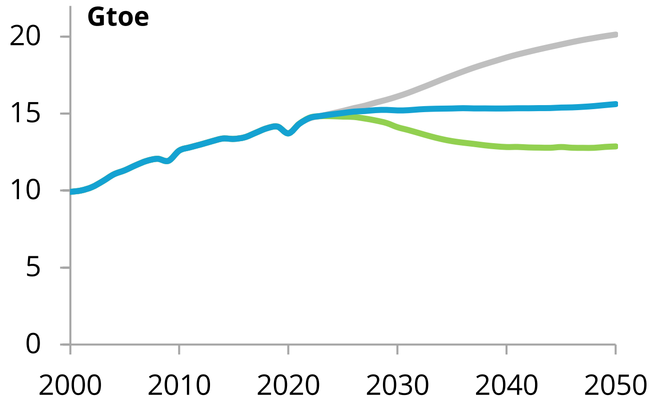
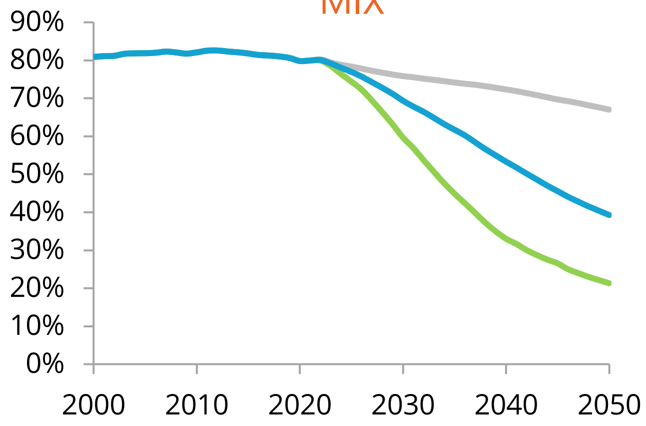
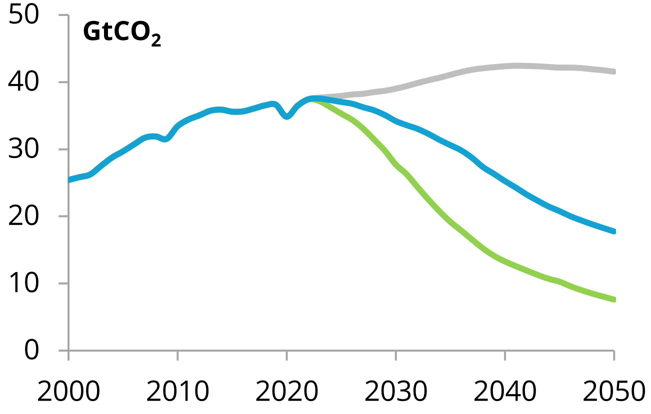
PRIMARY ENERGY CONSUMPTION



SHARE OF FOSSIL IN ENERGY MIX



CO_2 EMISSIONS



Average evolution (%/y)	2011-2022	2022-2050		
		EnerBase	EnerBlue	EnerGreen
Carbon intensity CO_2 emissions released to produce one unit of gross domestic product (GDP)	**-2.2%**	**-2.9%**	**-5.8%**	**-8.6%**
Energy intensity of GDP (final) Energy consumption necessary to produce one unit of gross domestic product (GDP)	-1.6%	-2.3%	-3.0%	-3.7%
Carbon factor CO_2 emissions released for an average unit of energy consumption	-0.5%	-0.7%	-2.8%	-5.1%

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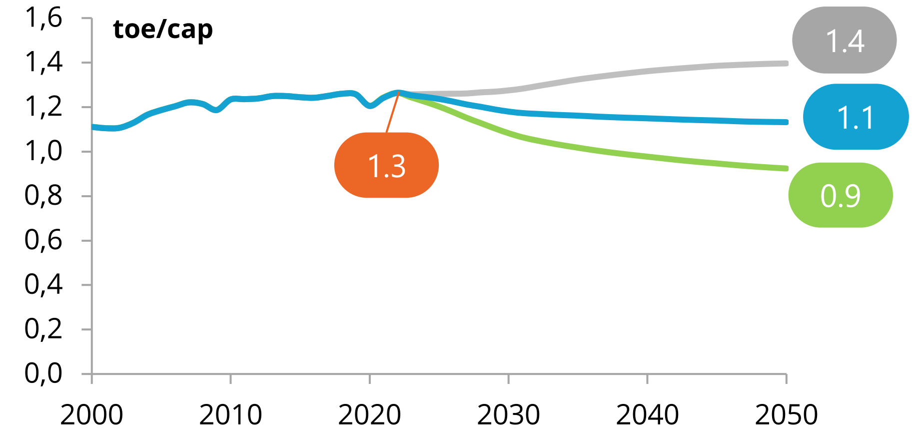
Final energy consumption

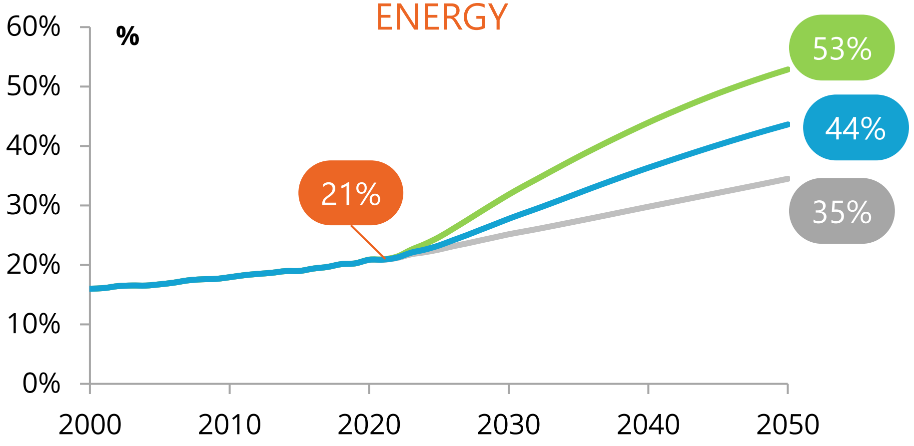
How should we transform the way we consume energy to reach our climate commitments?

World

FINAL ENERGY PER CAPITA



SHARE OF ELECTRICITY IN FINAL ENERGY



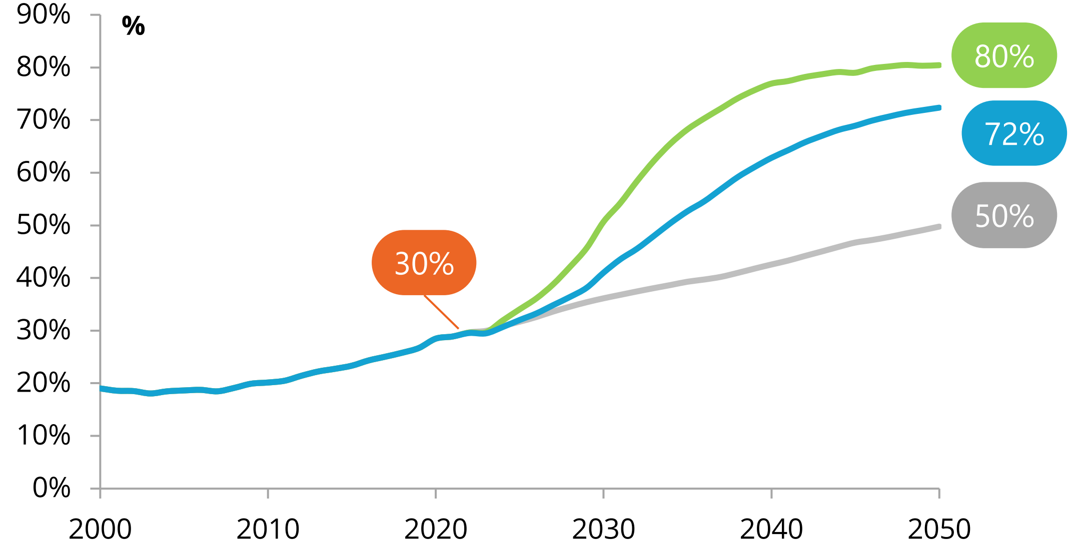
- Reducing energy needs has to be a focus towards decarbonisation
  - **Energy efficiency** across all end-uses
  - **Sufficency and behavioural changes** especially in advanced economies
  - Hence, final energy per capita decreases by 10% in EnerBlue and 27% in EnerGreen, in 2050
- Electricity emerges as the main fuel in final consumption in most end-uses
  - **Buildings heating** (e.g. heat pumps)
  - **Passenger & light freight transport** (electric vehicles)
  - **Low temperature processes** in industry (heat pumps)
  - **High temperature industrial** processes (e.g. electric arc furnaces)

CO_2-free energy supply

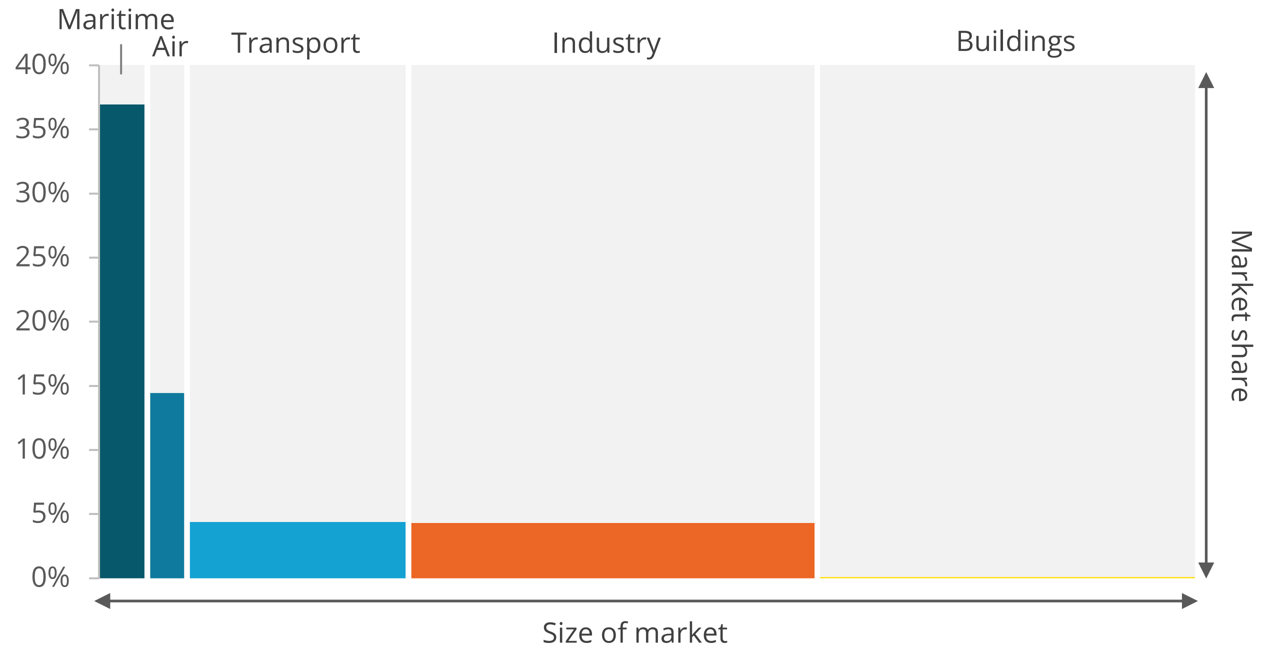
Decarbonising the energy supply is required for a successful reduction of our emissions

World

SHARE OF RENEWABLES IN ELECTRICITY GENERATION



SHARE OF HYDROGEN IN FINAL CONSUMPTION IN 2050 IN ENERGREEN



- **Electricity generation** needs to be **quickly decarbonised** to reach ambitious climate targets.
- Renewables will supply most of the electricity by 2050.

- **Green hydrogen** can help to decarbonise hard-to-abate sectors, including **international maritime & air** transport, **heavy freight transport**, **high-temperature industrial uses**.

Emissions per capita

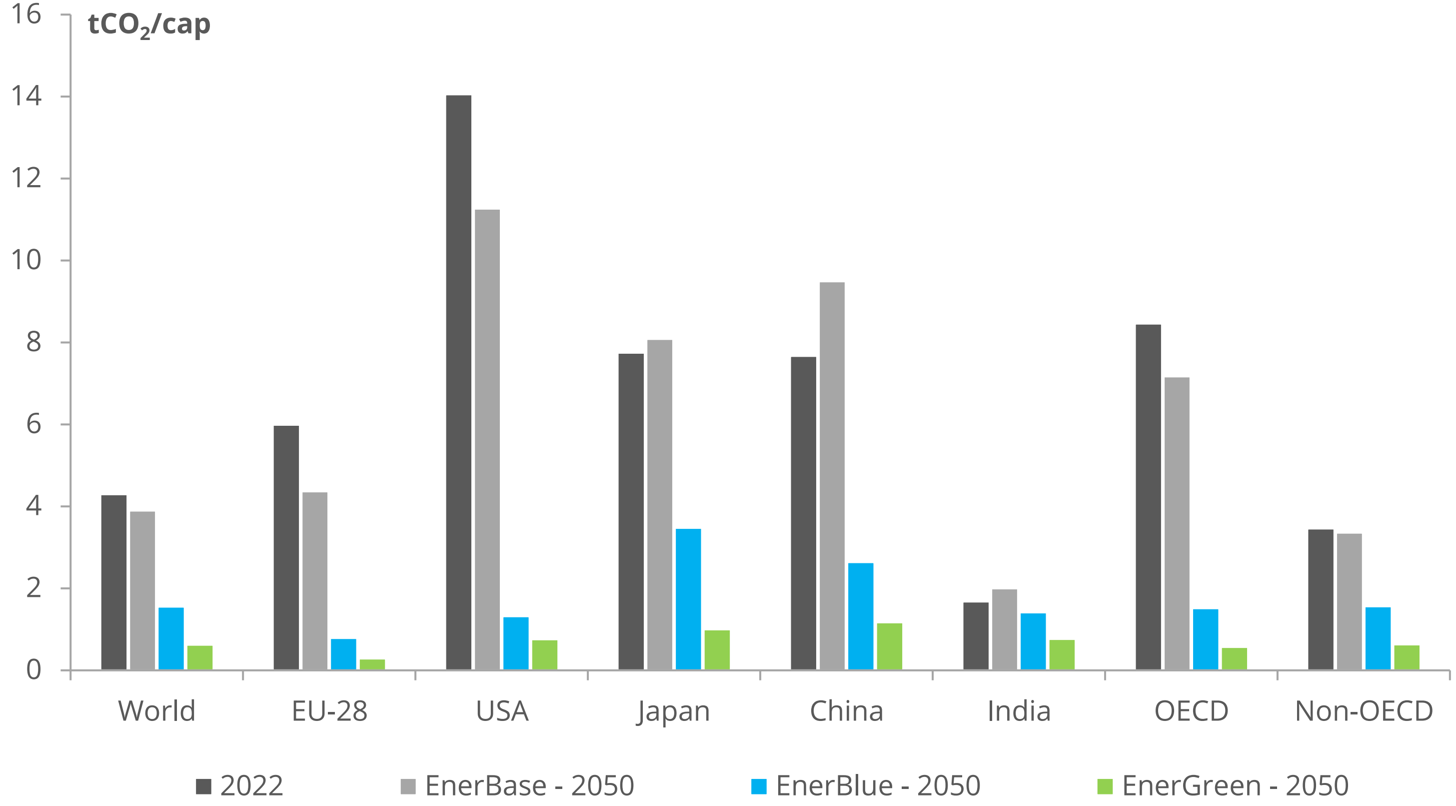
To what extent does the global picture hide regional discrepancies?

World

- **Large historical discrepancies in emissions per capita**
  - Reflecting different **development levels**
  - And different **shares of fossil** in the primary mix

- **A completely different picture in 2050 in EnerBlue**, and **EnerGreen**
  - Low emissions per capita in OECD countries by 2050 (1.5 tCO_2/cap in EnerBlue)
  - Large decrease also in non-OECD countries, converging towards OECD average (1.6 tCO_2/cap in 2050 in EnerBlue)

CO_2 emissions per capita – 2050 (fuel combustion)



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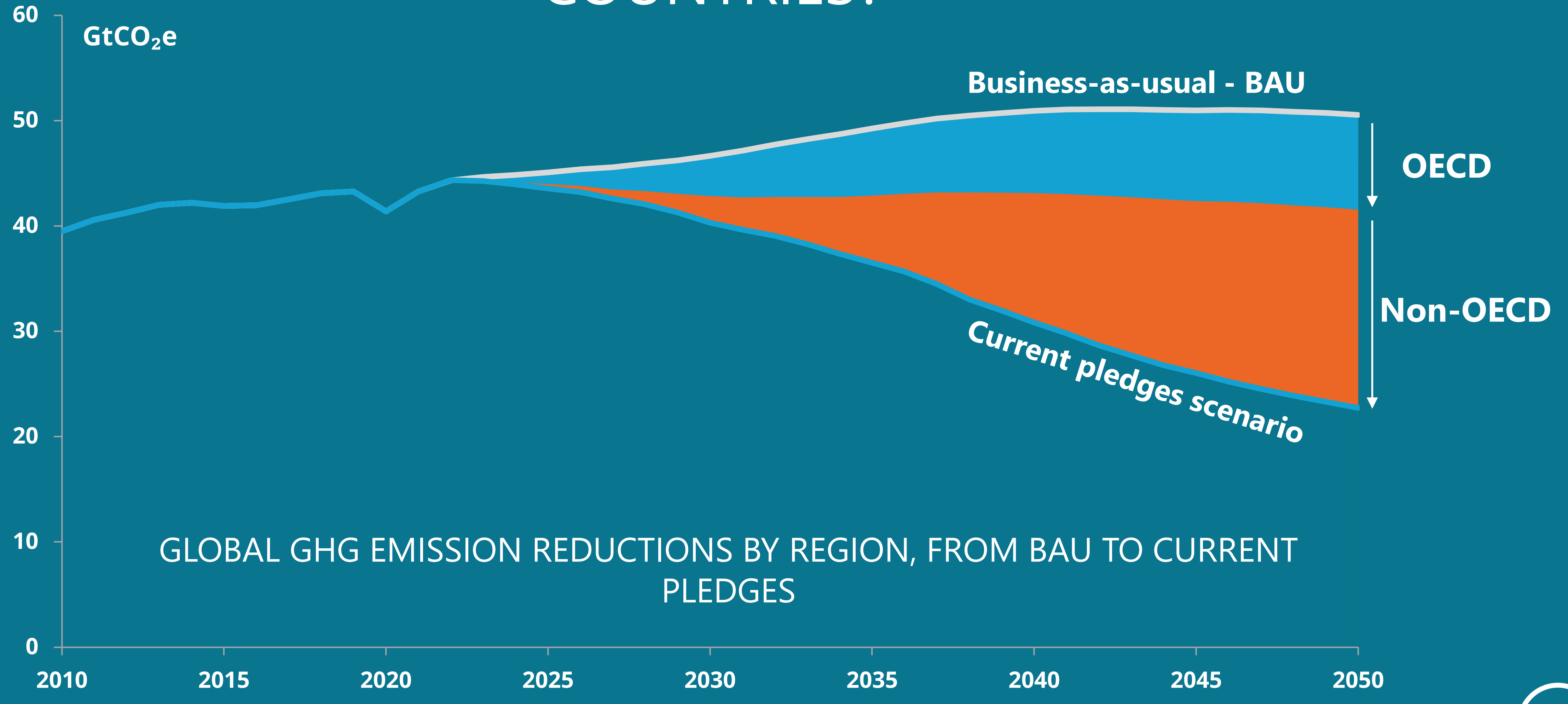
HOW IS GLOBAL CLIMATE AMBITION SHARED ACROSS COUNTRIES?



GLOBAL GHG EMISSION REDUCTIONS BY REGION, FROM BAU TO CURRENT PLEDGES

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Source: Enerdata – EnerFuture scenarios

Comparative cost of scenarios
How much more expensive is a 2°C-compatible pathway compared to a reference?

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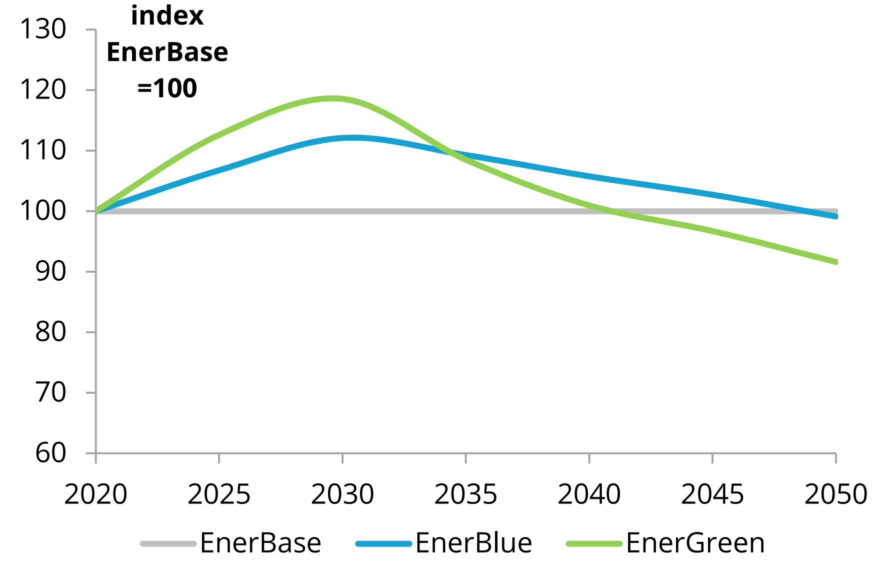
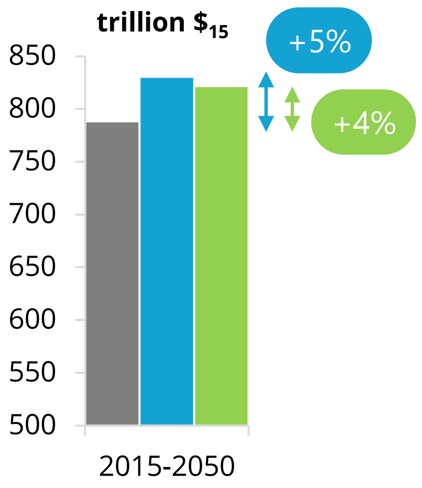
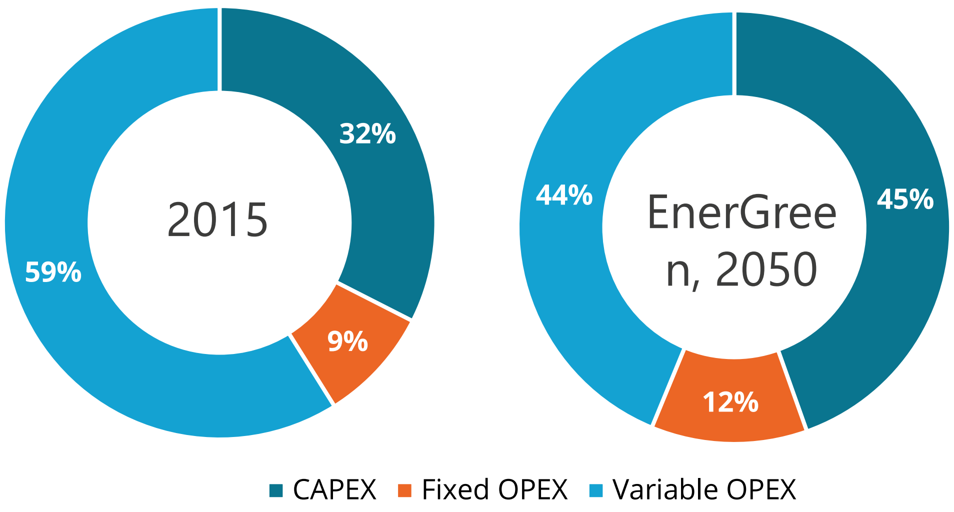
TOTAL SCENARIO COSTS COMPARED TO ENERBASE



CUMULATED SCENARIO COSTS 2015-2050



SCENARIO COST STRUCTURE



- **Unlocking short-term investments** is necessary
- **These investments would become profitable after 2050** compared to a baseline scenario
- Energy systems are moving **from an OPEX to a CAPEX cost structure** as renewables develop
- The **environmental cost of inaction** is much higher than the additional ~5%

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Recap: 2050 snapshot

What would a « well below 2°C » world look like in 2050?

EnerGreen scenario

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EFFICIENCY & SUFFICIENCY

- **Final energy demand** vs. BAU

- 25% Efficiency gains
- 10% Sufficiency gains

ELECTRIFICATION

x2.5 Electricity share vs 2022

- 65% Electric cars in the fleet
- 50% Heat pumps in space heating

CLEAN ENERGY SUPPLY

÷4 Fossil fuel consumption vs 2022

- 95% CO_2-free electricity
- 90% H_2 from electrolysis

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