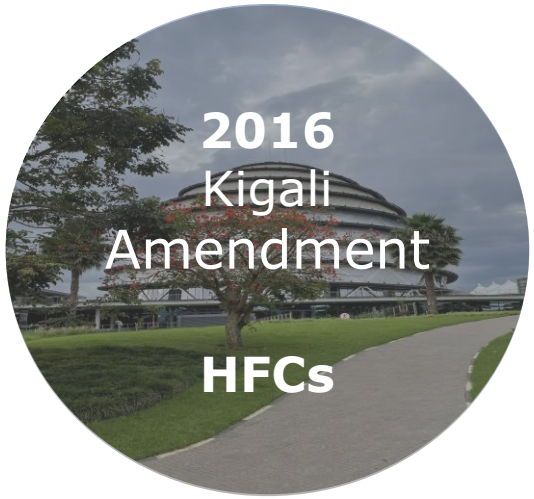
PRESENTING

RETHINK
LIVE

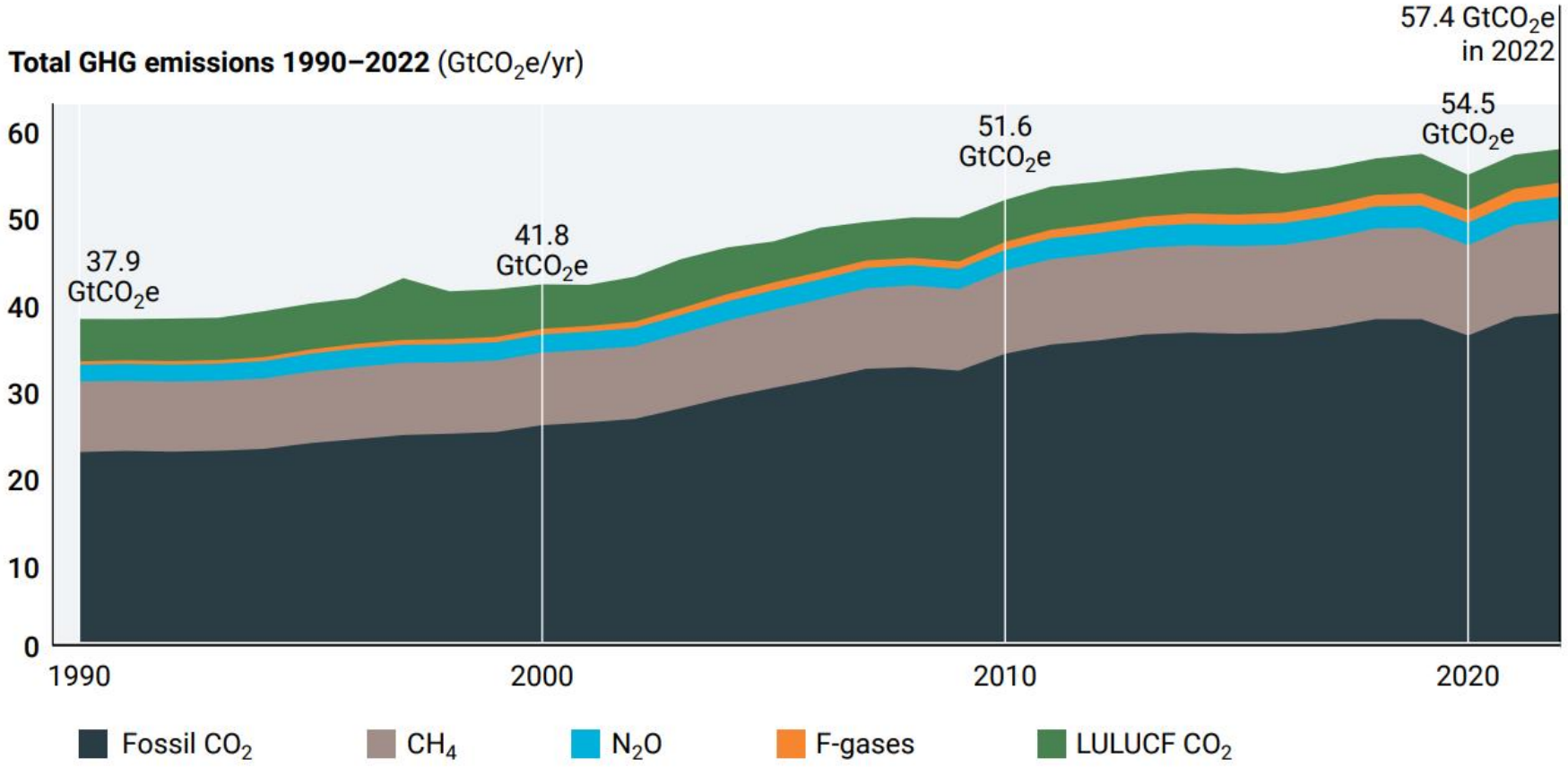
Cooling in the spotlight at COP28 - what was the outcome?

Milestones: Climate & Environment

RETHINK LIVE



Limit Global Warming to **1.5°C: 7 Greenhouse Gases**

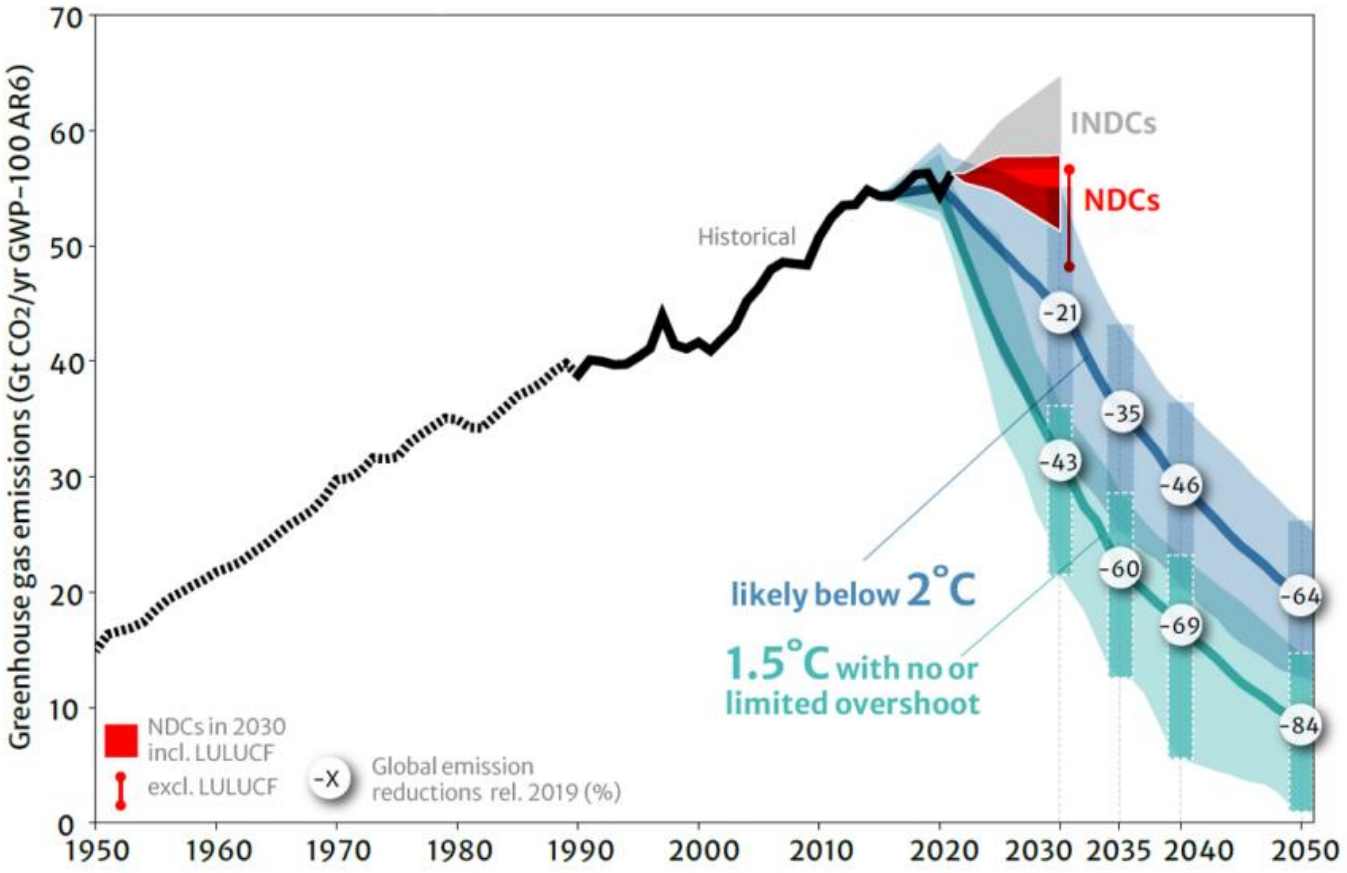


Basket of 7 Greenhouse gases

- CO2, CH4, N2O, SF6, HFCs, PFCs, NF3
- F-Gases covered by Climate Convention and by Montreal Protocol

Source: UNEP Emissions Gap Report, 2023

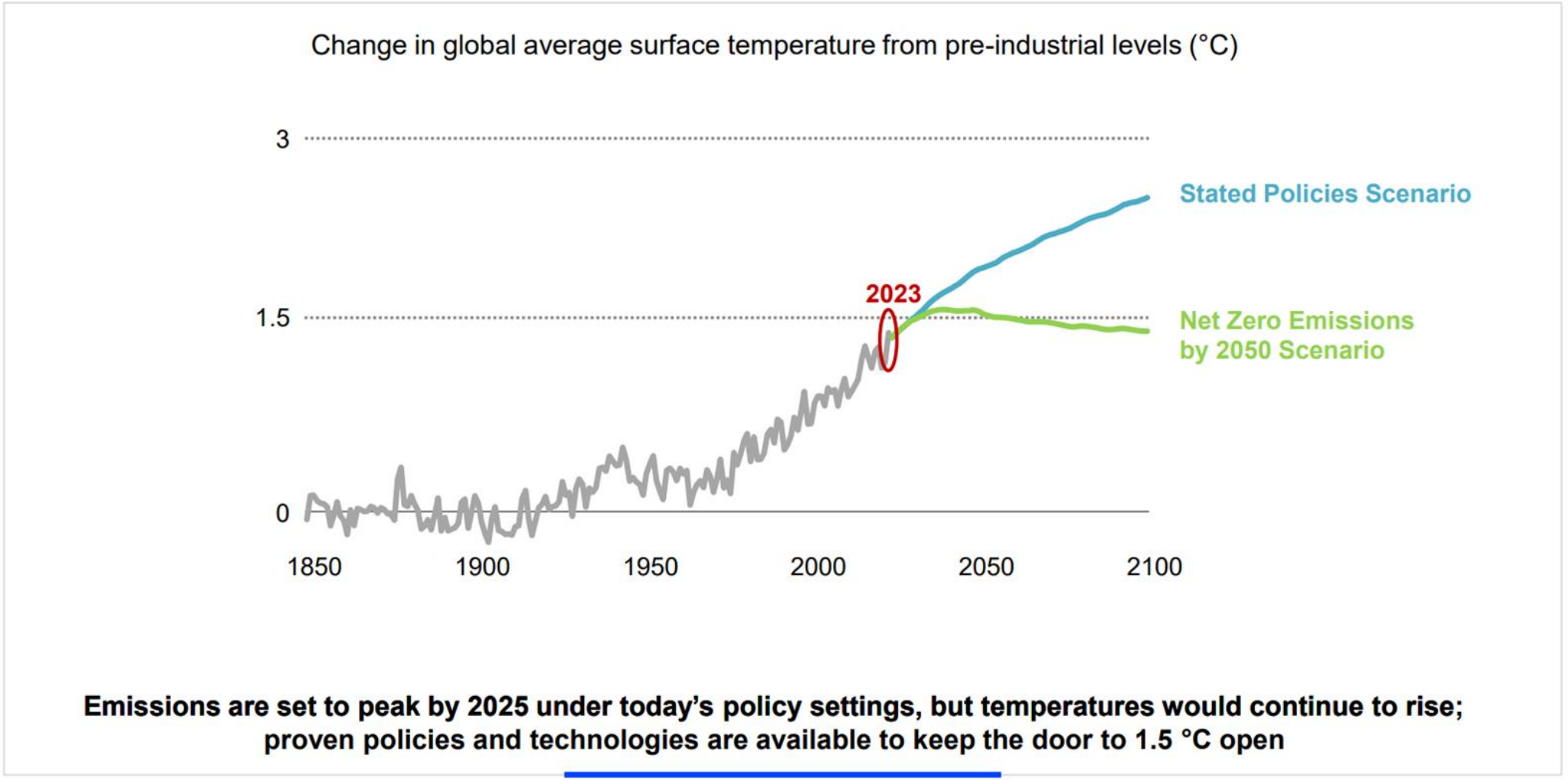
Nationally Determined Contributions: **The Gap is Huge**



- Countries commit to **Nationally Determined Contributions (NDCs)** to limit their greenhouse gas emissions
- **The Global Stocktake Report** shows that global warming will be above 1.5°C and 2.0°C with current NDCs
- **NDCs will need to be updated in 2025.** Actions must be stepped up significantly to keep 1.5°C within reach

Source: UNFCCC Global Stock Take Report, 2023

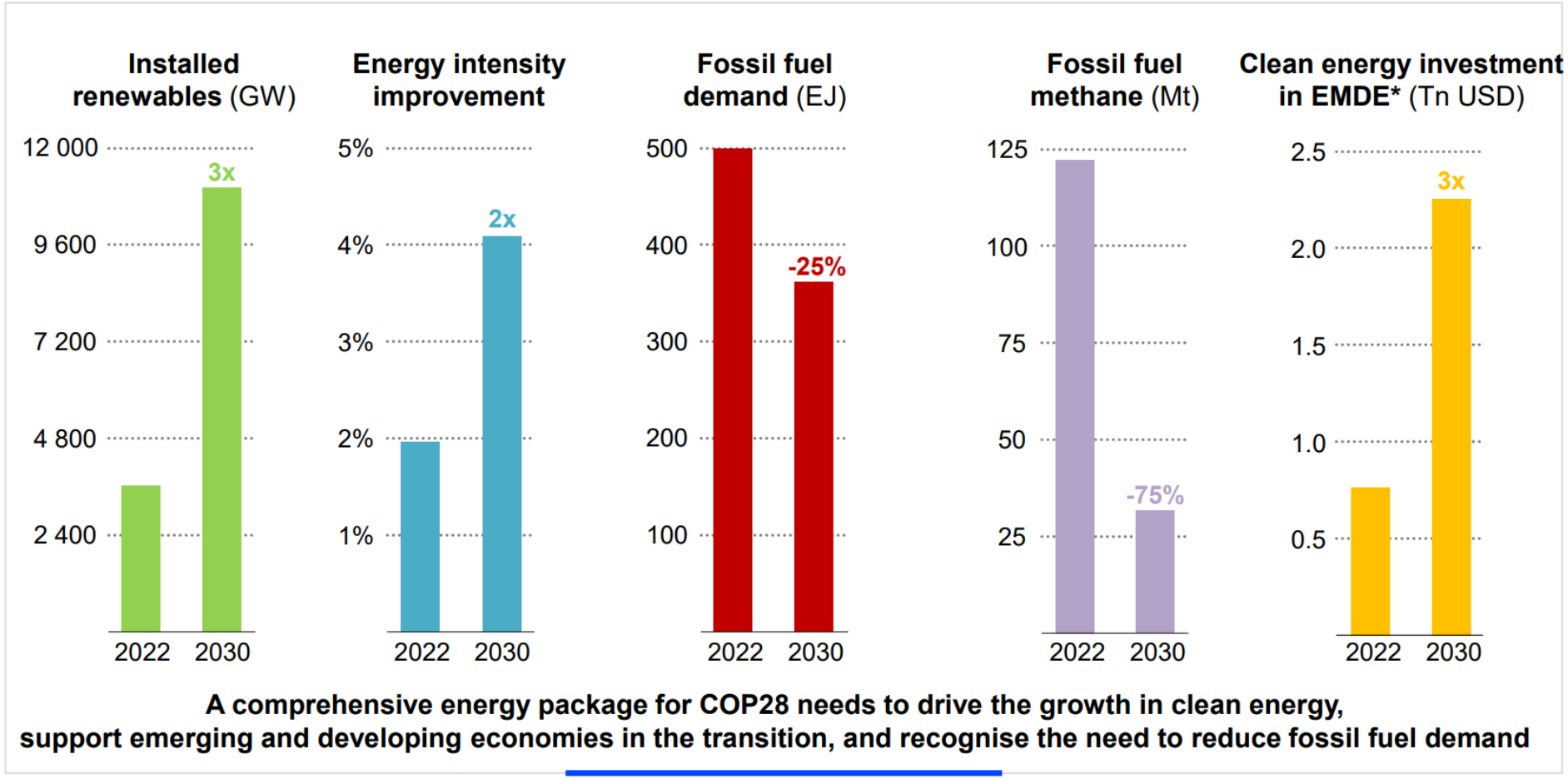
We are at a crossroads



Source: IEA World Energy Outlook, 2023

Fossil Fuel Phase-Out

Five pillars to keep 1.5 °C alive



* EMDE = emerging market and developing economies

Source: IEA World Energy Outlook, 2023

Double Energy Efficiency – Triple Renewables

123 States (status 11 Dec 2023) commit to:

- **Triple the world's installed renewable energy generation capacity** to at least 11,000 GW by 2030
- **Double the global average annual rate of energy efficiency improvements** from around 2% to over 4% every year until 2030.
- Put the principle of **energy efficiency as the "first fuel"** at the core of policymaking, planning, and major investment decisions.

66
Countries so far

- **Reduce cooling related emissions by 68%** by 2050 relative to 2022, in line with 1.5°C target
- Commit to **ratify the Kigali Amendment** by 2024, if not done already
- Support robust action through the Montreal Protocol Multilateral Fund for **early action to reduce HFC consumption and to promote improved energy efficiency**
- Commit to establish **national cooling action plans** and reflect efforts in NDCs and HFC phase-down plans
- Commit to **buildings energy codes and MEPS** ….

Full Text of Global Cooling Pledge

Outcome of COP28 in Dubai: A new milestone?

RETHINK LIVE

To limit global warming to 1.5°C, greenhouse gas emissions must (relative to 2019) :

- Be cut by 43% by 2030
- Be cut by 60% by 2035
- Reach net zero by 2050

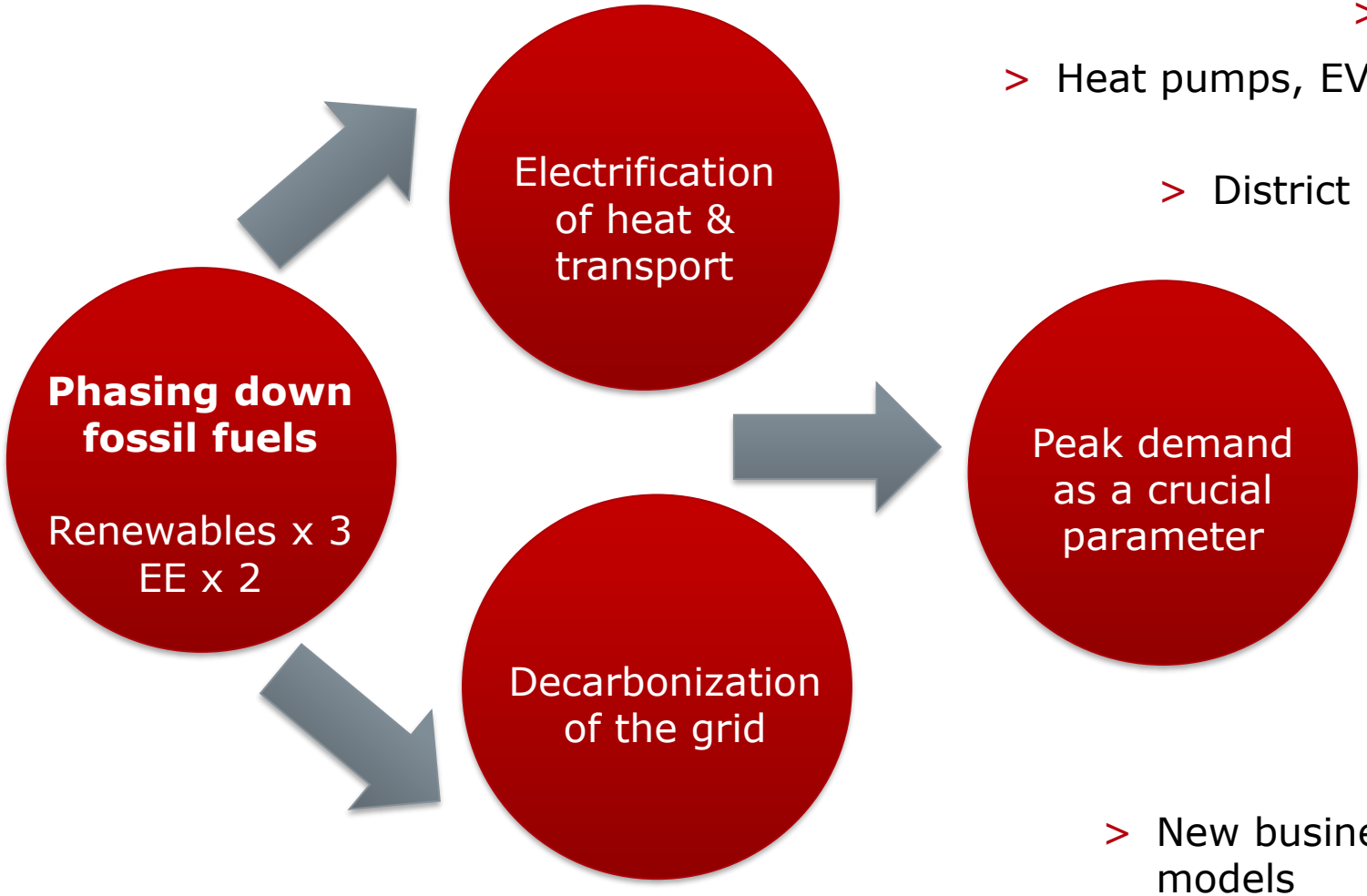
Commitments targeting fossil fuel phase-down

1. **Triple renewable** energy capacity globally and **double** the global average annual rate of **energy efficiency** improvements by 2030;

2. **Transition away from fossil fuels in energy systems, in a just, orderly and equitable manner**, accelerating action in this critical decade, so as to achieve net zero by 2050 in keeping with the science;

3. **Phase out inefficient fossil fuel subsidies** that do not address energy poverty or just transitions, as soon as possible

How will it **impact** the heating & cooling industry?



> Thermal & electrical storage

> Heat pumps, EVs

> Speed controlled motors

> District Energy

> Digital solutions & artificial intelligence

> Circular use of energy and resources, waste heat recovery

> Low Global Warming Potential Refrigerants

> New business & finance models

> New materials

ENGINEERING TOMORROW

The Science behind the pledge: Keeping it chill

Ray Gluckman, Gluckman Consulting

Pathways to Near-Zero Emission Cooling

Analysis of Global Cooling GHG Emissions

based on UNEP Report: Global Cooling Watch 2023

presentation by Ray Gluckman
December 2023

Gluckman Consulting
specialists in refrigeration and climate change

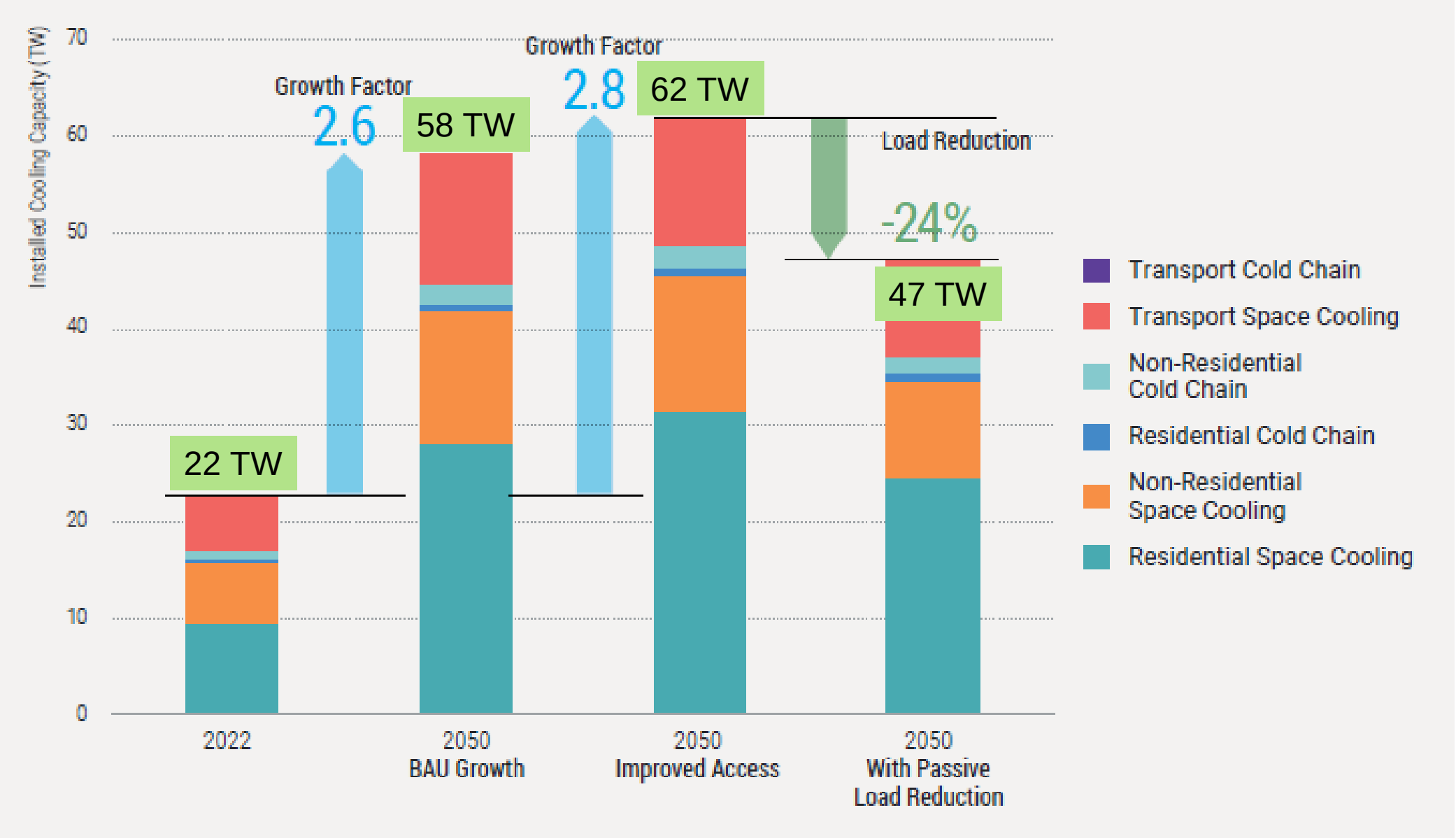
Background to Cooling Emissions

- in 2022 cooling is estimated to have:
  - consumed 20% of global electricity
  - created 7% of global GHG emissions
- use of cooling will grow significantly by 2050
  - driven by:
    - population growth
    - GDP growth
    - climate change
- 2050 cooling capacity likely to be 3 times higher than in 2022
- how can that be achieved without a massive increase in GHG emissions?

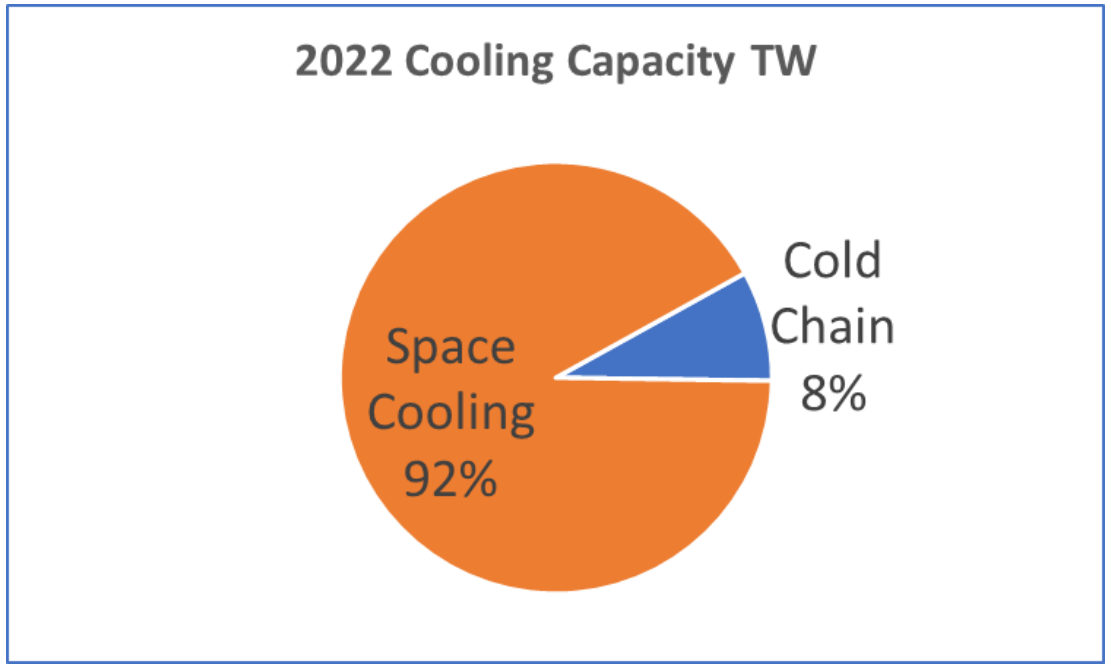
UNEP Global Cooling Watch 2023

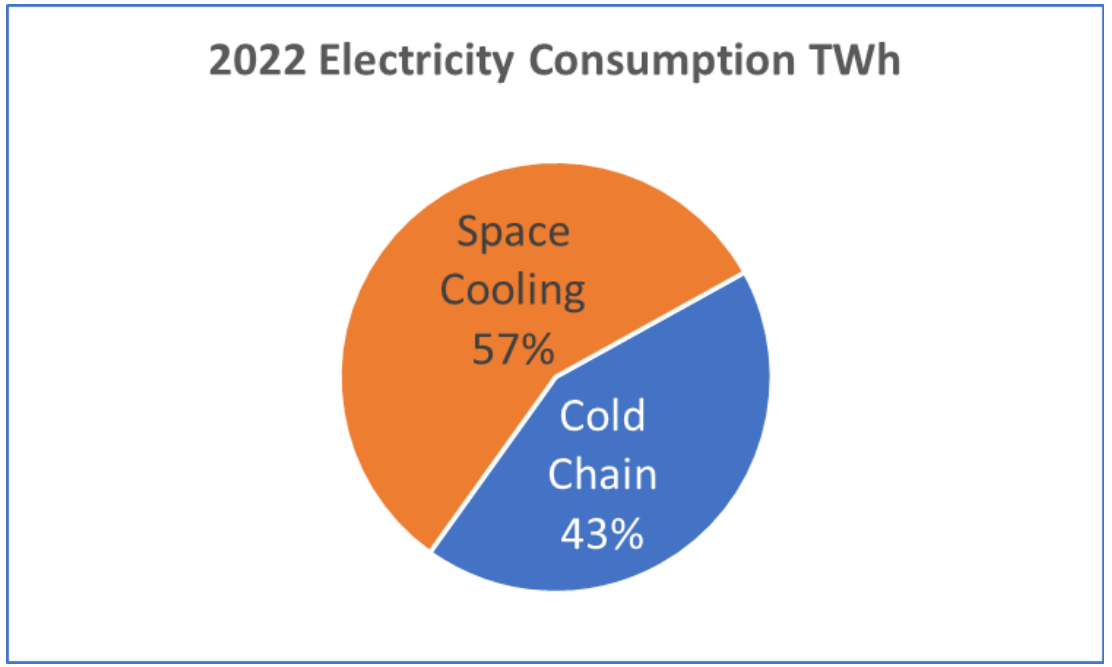
- analysis of global cooling markets, with forecasts to 2050
- includes assessment of all types of “active” cooling including:
  - Air-Conditioning
    - residential buildings, non-residential buildings and in cars / other transport
  - Refrigeration
    - domestic, food retail, food service, cold chain, industrial
- analysis provided from the Global Cooling Emissions Model
  - comprehensive analysis of direct and indirect emissions from global cooling applications
- also, survey results of national regulatory landscape for sustainable cooling across 193 countries

Cooling Equipment Stock Growth



Global Installed Capacity and Energy Consumption Stationary Cooling Equipment

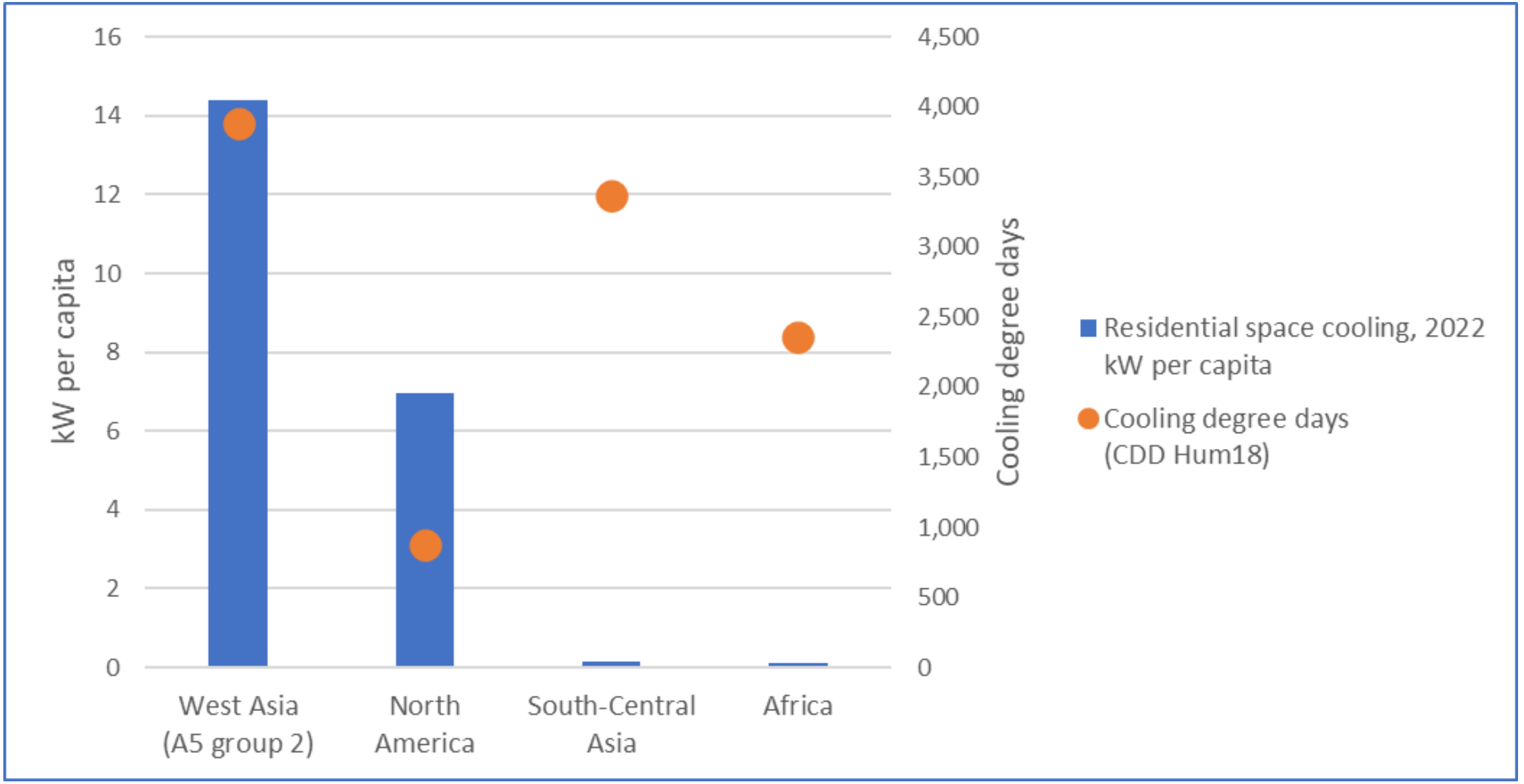




Space cooling is dominant – and a key driver of peak electricity demand in hot countries

Refrigeration applications much more “visible” in terms of electricity used – due to long running hours

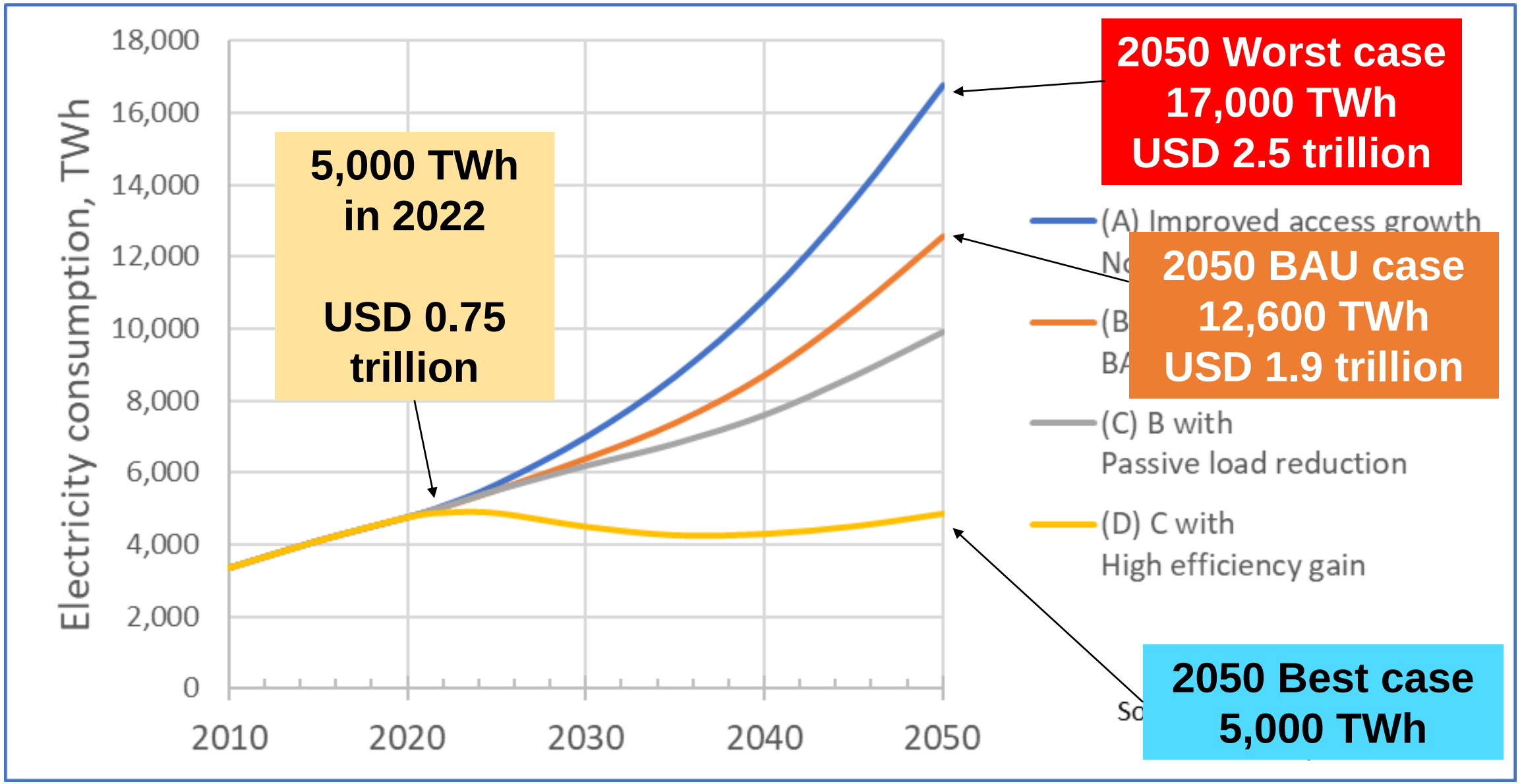
Lack of Residential AC in Hot Developing Countries



Energy Efficiency Potential

Energy efficiency scenario	Description
No efficiency gain	Efficiency levels of new equipment are frozen at 2022 levels. This is a counterfactual without-measures scenario.
BAU efficiency gain	Medium energy efficiency levels are introduced slowly. This is the BAU pathway, with efficiency improvement being driven by relatively weak policies.
Mid efficiency gain	Medium energy efficiency levels are introduced more rapidly, and some high-energy efficiency levels are introduced.
High efficiency gain	High energy efficiency levels are introduced rapidly.

Global RACHP Energy Efficiency Pathways

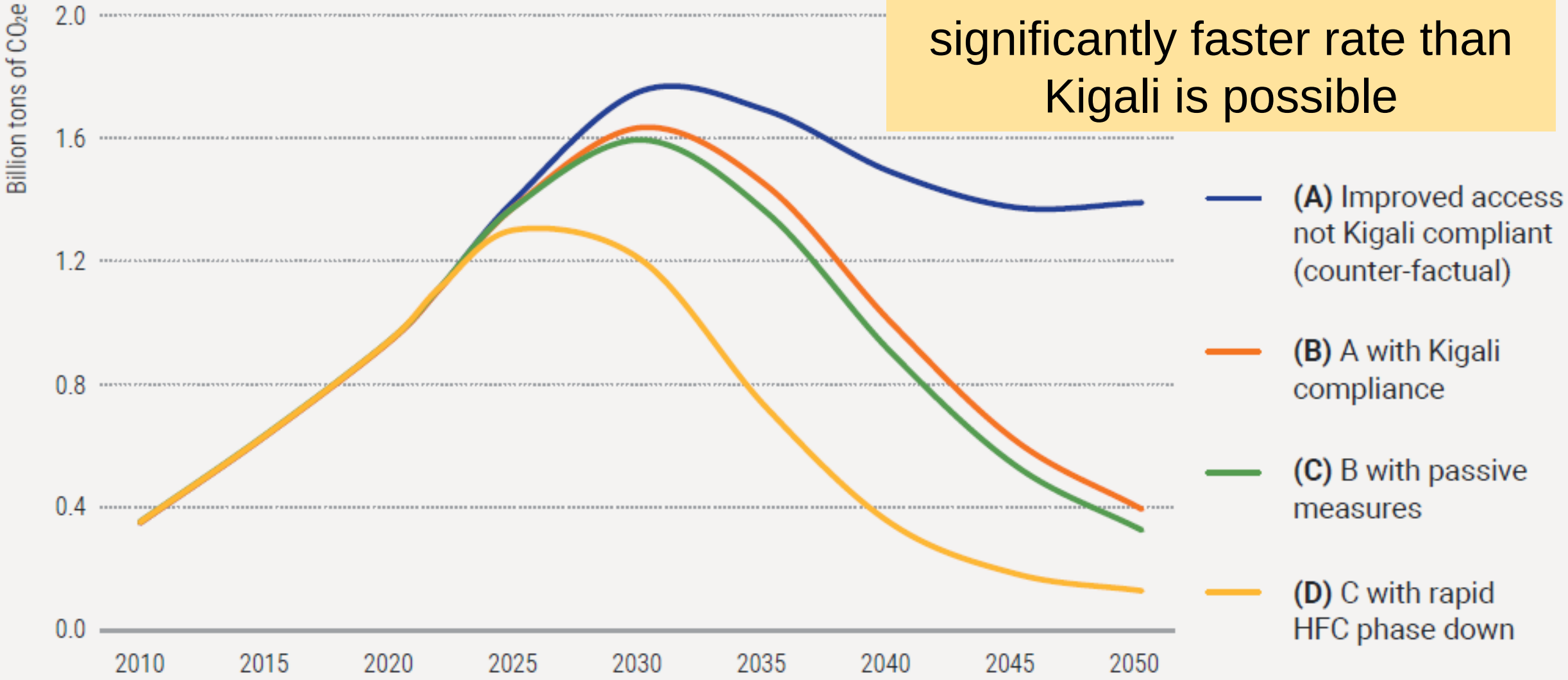


HFC Phase-Down Potential

HFC mitigation scenario	Description
Base Case	Slow transition away from high-GWP refrigerants without Kigali compliance. This is a counterfactual without-measures scenario.
Kigali Compliant (BAU)	Achieving the Kigali Amendment targets according to the schedule agreed by Parties to the Montreal Protocol in 2016. This is the BAU pathway, as most countries have already ratified the Kigali Amendment.
Faster Action	A faster phase down of HFCs than required under the Kigali Amendment.
Rapid HFC Phase Down	Rapid uptake of low-GWP technologies and emission reduction policies. This is a realistic Best Cooling Measures pathway that is based on the use of low-GWP technologies already in use in some regions.

Global RACHP HFC Phase-Down Pathways

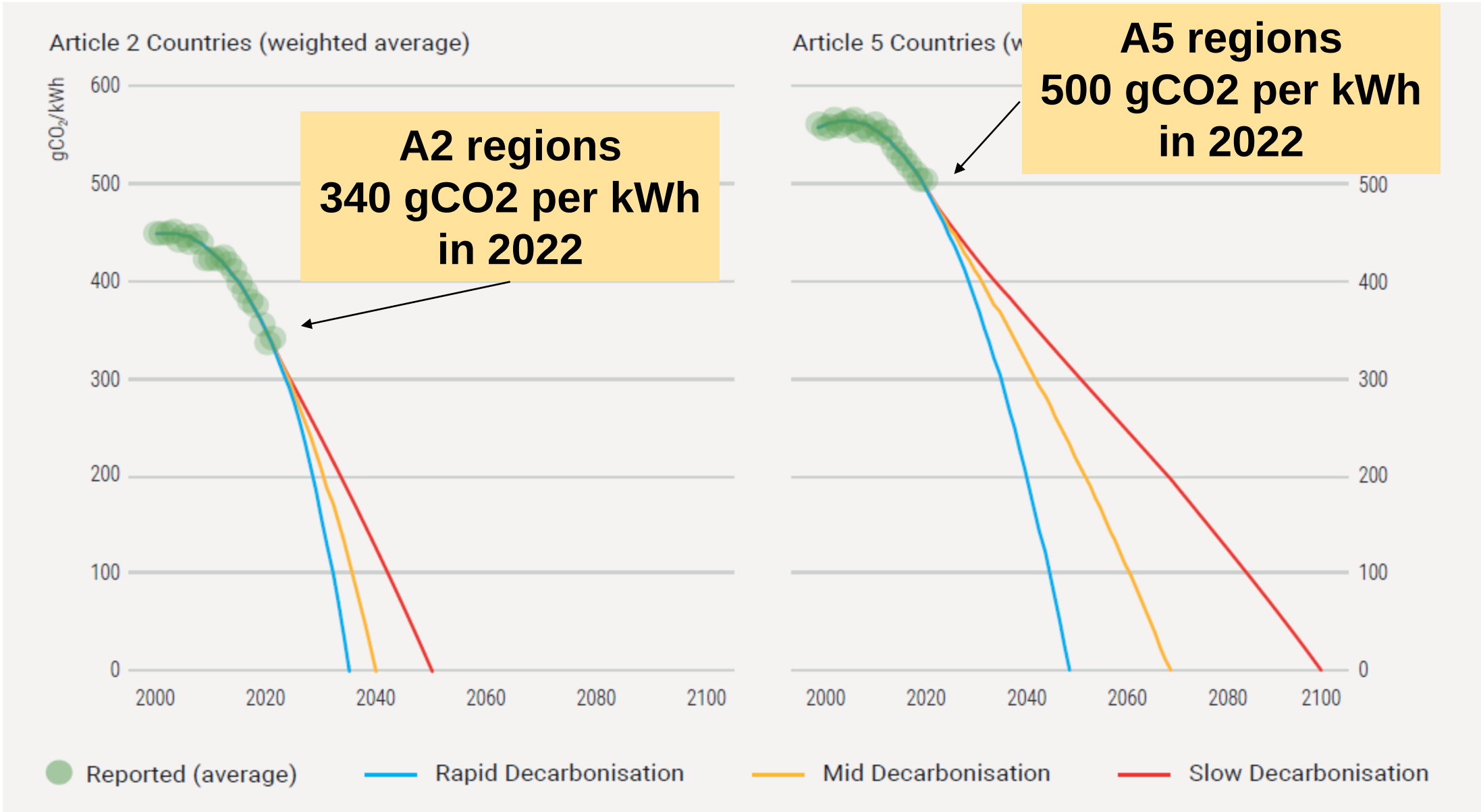
HFC Phase-Down at a significantly faster rate than Kigali is possible



Electricity Grid Decarbonisation Scenarios

Grid decarbonization scenario	Developed countries	Developing countries
BAU decarbonization	Reaching zero in 2050	Reaching zero in 2100
Mid decarbonization	Reaching zero in 2040	Reaching zero in 2070
Rapid decarbonization	Reaching zero in 2035	Reaching zero in 2050

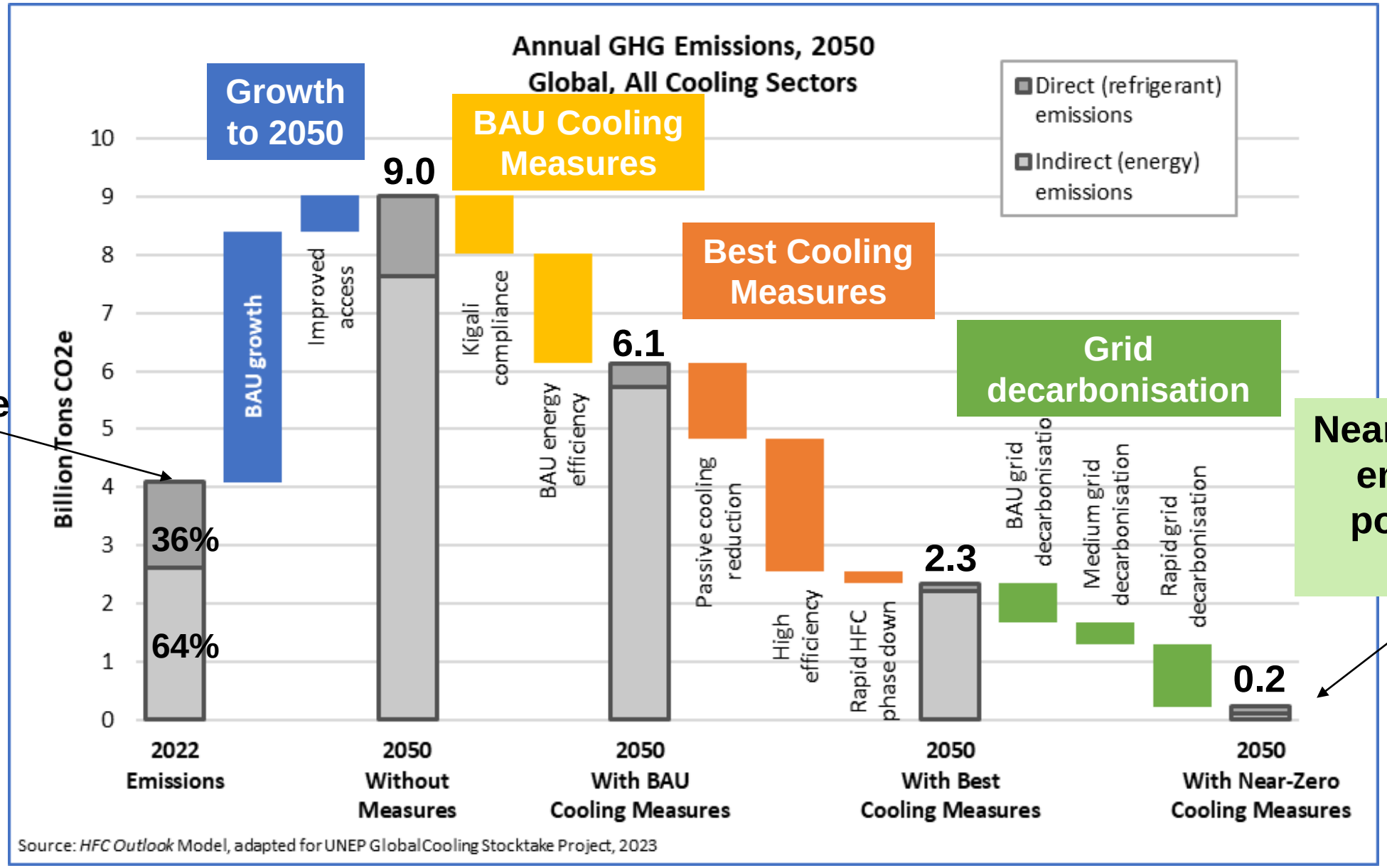
Electricity Grid Decarbonisation Pathways



How can we achieve Best Case to minimise energy use?

- **Much can be achieved with currently available technologies**
- **Cooling Load Reduction Measures**
  - building measures e.g. reflective surfaces, shading etc.
  - cold chain measures e.g. doors on retail displays
- **New equipment energy efficiency**
  - best available units are often 2 to 3 times more efficient than average sold
  - various policies can support this: e.g. MEPS, energy labels, financing
- **Operating efficiency of existing equipment**
  - training and awareness campaigns will help users maximise efficiency
- **R&D to deliver higher energy efficiency of new products**
  - e.g. Global Cooling Prize showed 5 times improvement in EE possible

Global GHG Emission Reduction Potential for RACHP



4.1 billion tons CO2e in 2022

Near-zero GHG emissions possible in 2050

Concluding Remarks

- excellent potential for cooling load reduction, improved energy efficiency and faster HFC phase-down
- much can be achieved by accelerated uptake of existing technologies
- even more is possible with further product developments
- together with rapid grid decarbonisation a 96% cut in 2050 emissions is possible
- barriers to reducing RACHP GHG emissions are well understood
  - Governments and industry must implement appropriate policies to overcome these barriers