How do we assess emissions globally?

ENOUGH Workshop

Manchester, 13 August 2025

Ray Gluckman - ray@gluckmanconsulting.com

Tim Thurnham - timth@live.com

ENOUGH

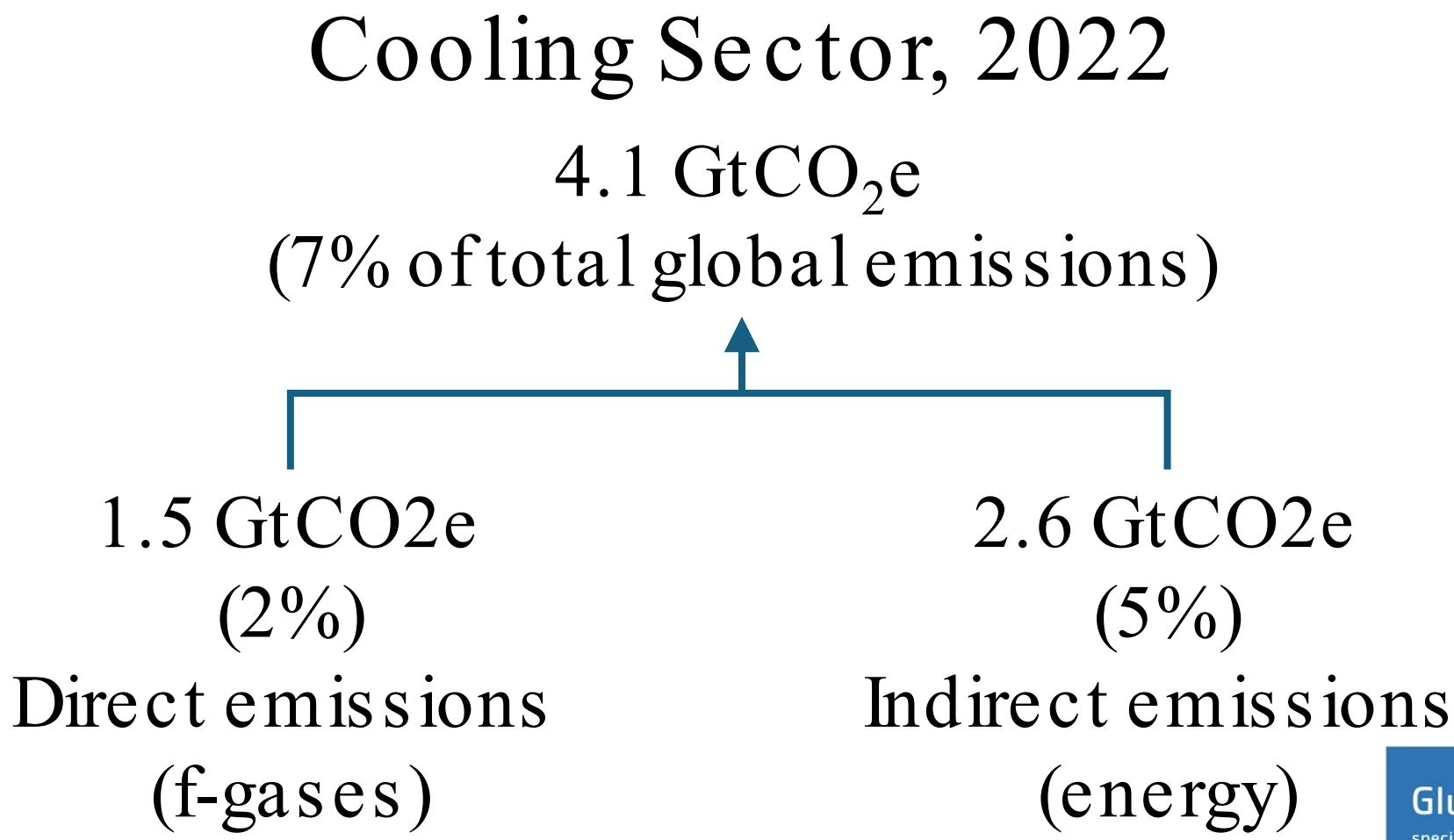
EUROPEAN FOOD CHAIN SUPPLY TO REDUCE GHG EMISSIONS BY 2050

Gluckman Consulting

specialists in refrigeration and climate change

Why do we assess emissions globally?

Why do we assess emissions globally?

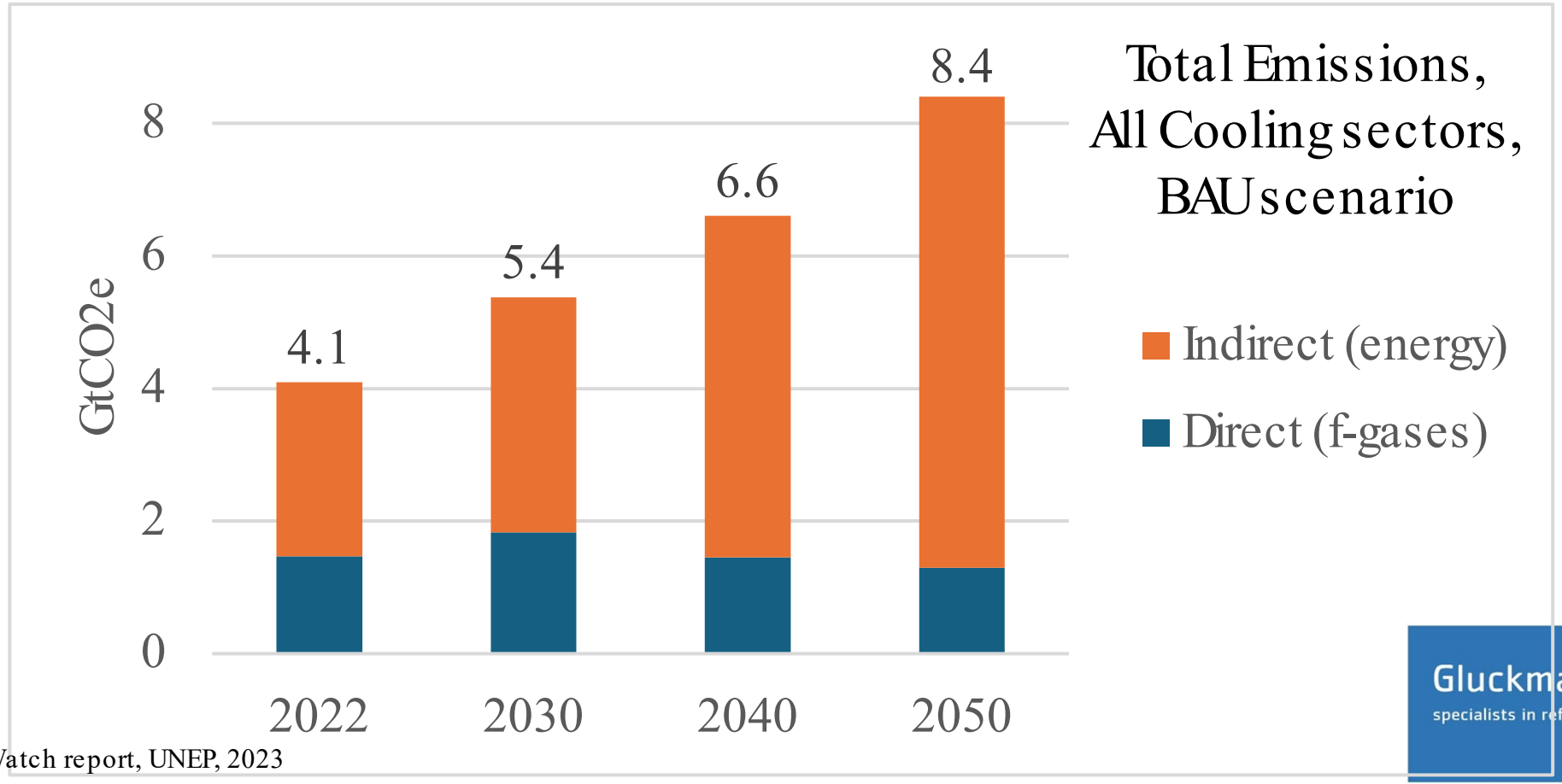


Source: Global Cooling Watch report, UNEP, 2023

Gluckman Consulting
specialists in refrigeration and climate change

Why do we assess emissions globally?

Without action, emissions could double by 2050

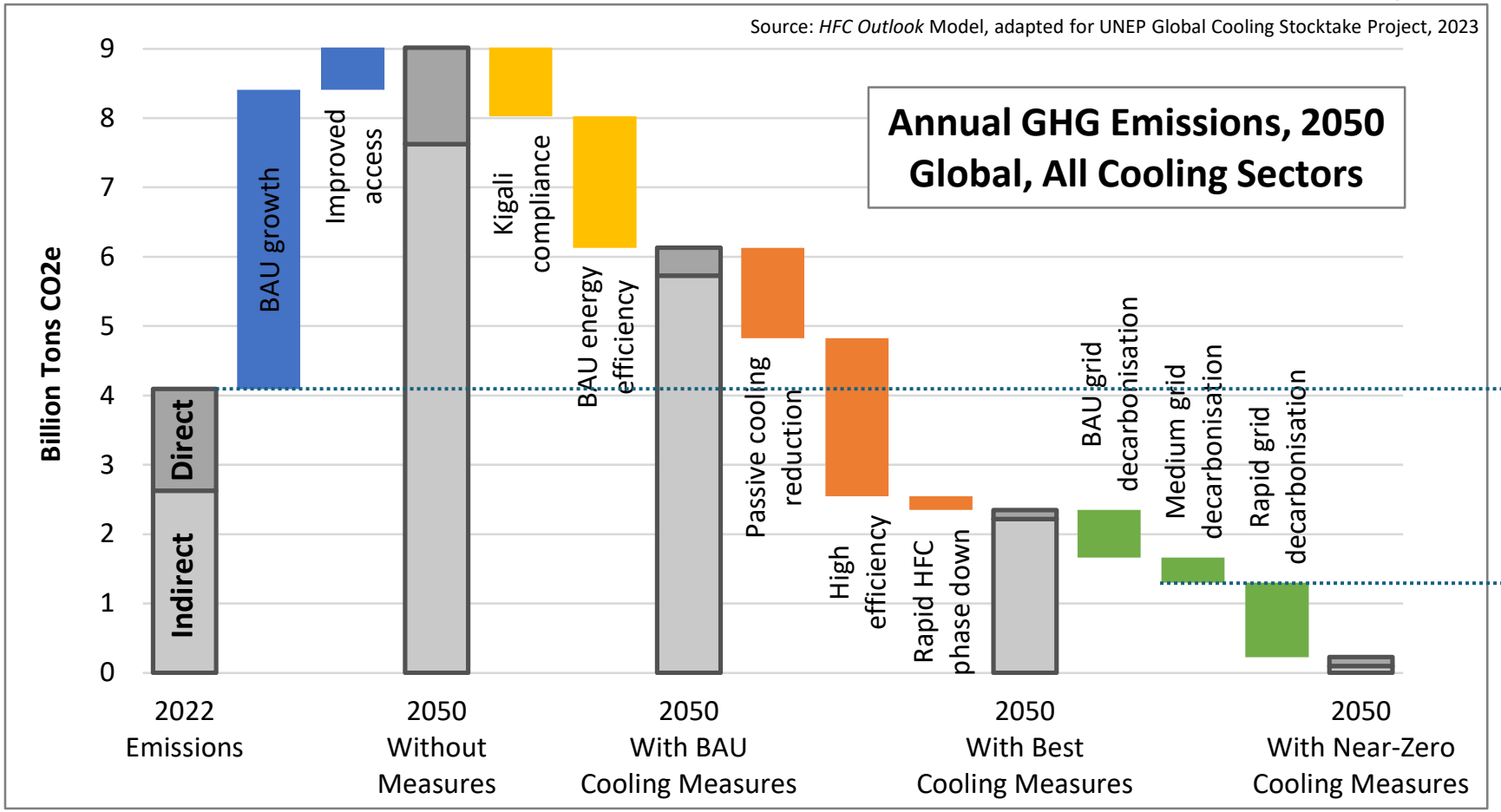


Source: Global Cooling Watch report, UNEP, 2023

Gluckman Consulting
specialists in refrigeration and climate change

Why do we assess emissions globally?

To achieve near-zero emissions by 2050 …



Global Cooling Pledge

-68%

Gluckman Consulting
specialists in refrigeration and climate change

Why do we assess emissions globally?

- To inform key stakeholders
  - National and international policy makers
  - National ozone units
  - Industry stakeholders (manufacturers, importers, contractors, etc)

- By assisting them in assessing:
  - Effective policy measures (industry regulations, use-bans, consumption quotas, etc.)
  - Achievable phase-down or phase-out profiles
  - Effective mitigation measures to reduce consumption and emissions to meet the targets
  - Potential compliance gaps (the “Gap-o-meter”)

How do we assess emissions globally?

Global Cooling Emissions Model Inputs

Stock Model

- 14 geographic regions
- 6 sectors and 40 sub-sectors
- Sector characteristics (cooling capacity, life expectancy)
- Using algorithms, based on:
  - Population, climate & wealth
  - Number of households, buildings, vehicles, access-to-electricity, etc.

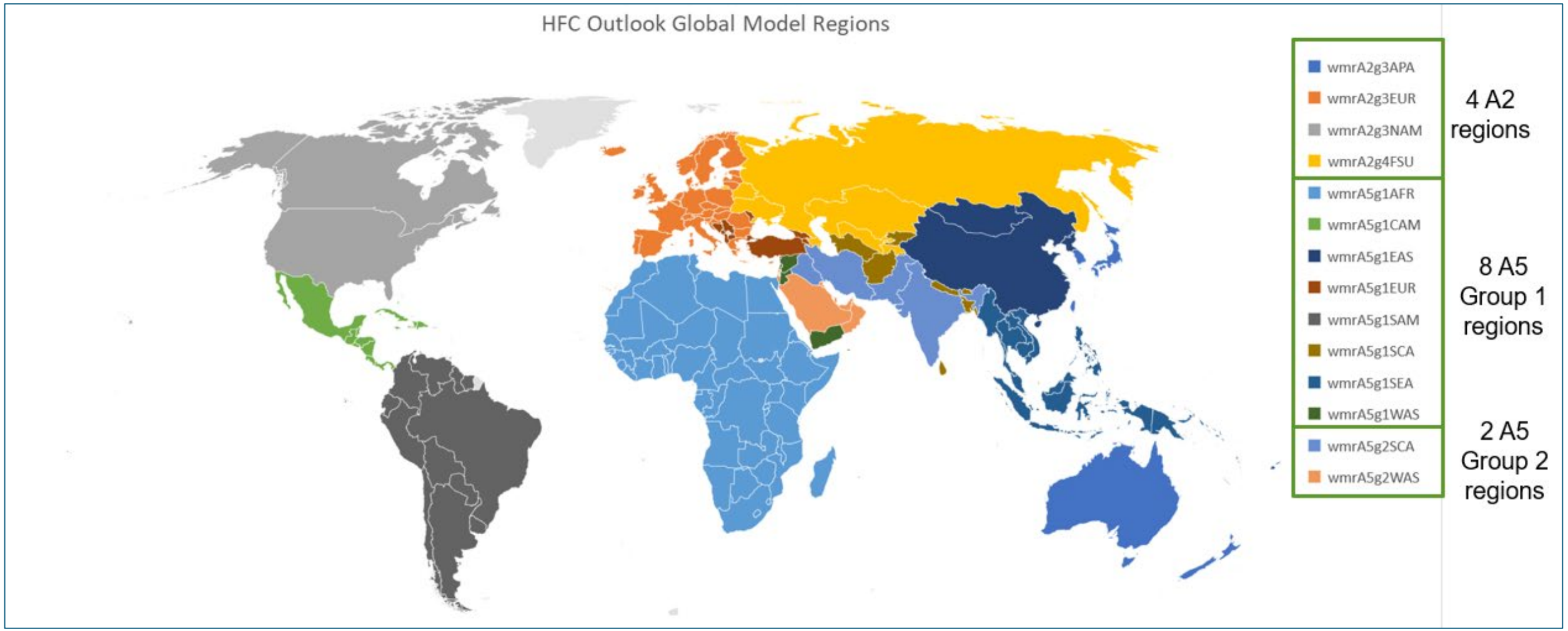
Refrigerants Model

- Refrigerant charge
- Refrigerant choices for new systems
- Leakage rates
- Recovery and re-use

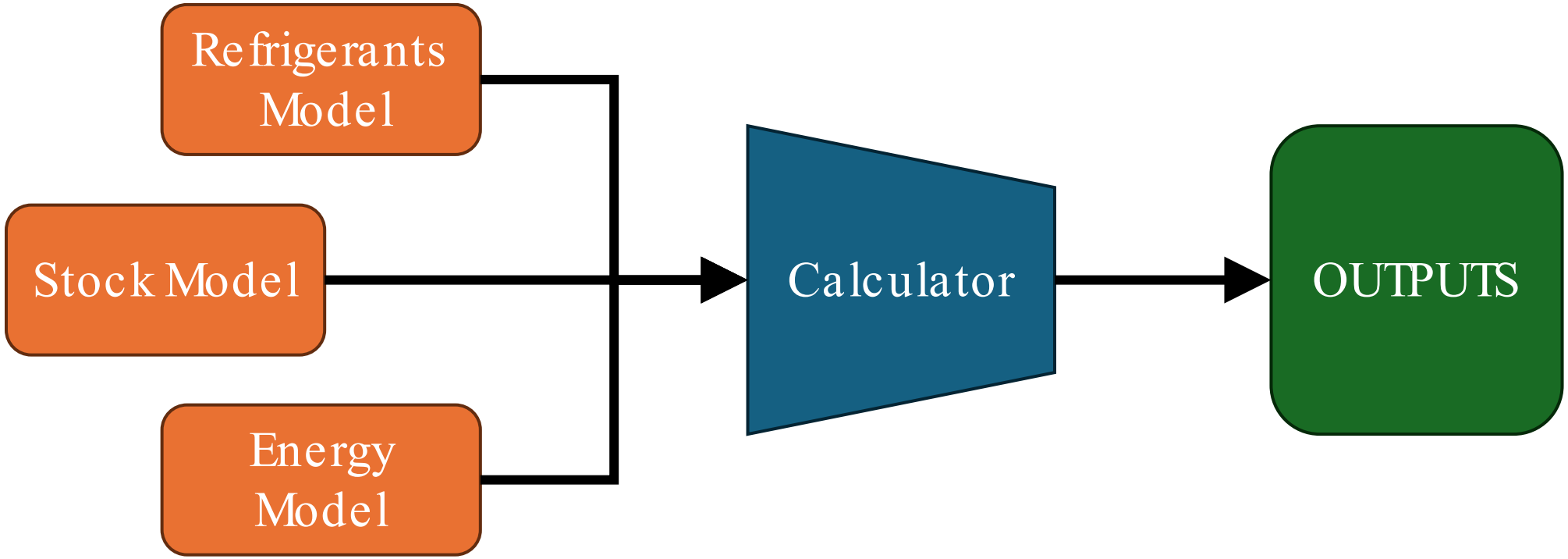
Energy Model

- Efficiency (AEER)
- Hours of use (EFLH)
- Efficiency of new systems
- Grid carbon factor

Global Regions



Global Cooling Emissions Model Data Flow



Gluckman Consulting
specialists in refrigeration and climate change

Global Cooling Emissions Model Outputs

Stock Model

- Number of items, and cooling capacity, for:
  - New systems
  - Systems in use
  - Systems at end-of-life
  - Systems for retrofill

Refrigerants Model

- Refrigerant bank
- Consumption
- Emissions
- Recovery and re-use

Energy Model

- Energy consumption
- Energy emissions
- For heat-pumps, avoided emissions due to displaced fossil-fueled heating

Global Cooling Emissions Model Outputs

Results available:

- Refrigerants model, results in: tonnes, ODP tonnes, tCO2e, or tTFA
- Energy model, results in: MW, MWh, or tCO2
- For: stock, banks, consumption, emissions &avoided emissions
- By technology sector and subsector
- By market sector (residential, commercial, industrial &transport)
- By refrigerant and refrigerant type
- By year, from 2000 to 2050

Gluckman Consulting
specialists in refrigeration and climate change

Global Cooling Emissions Model Challenges

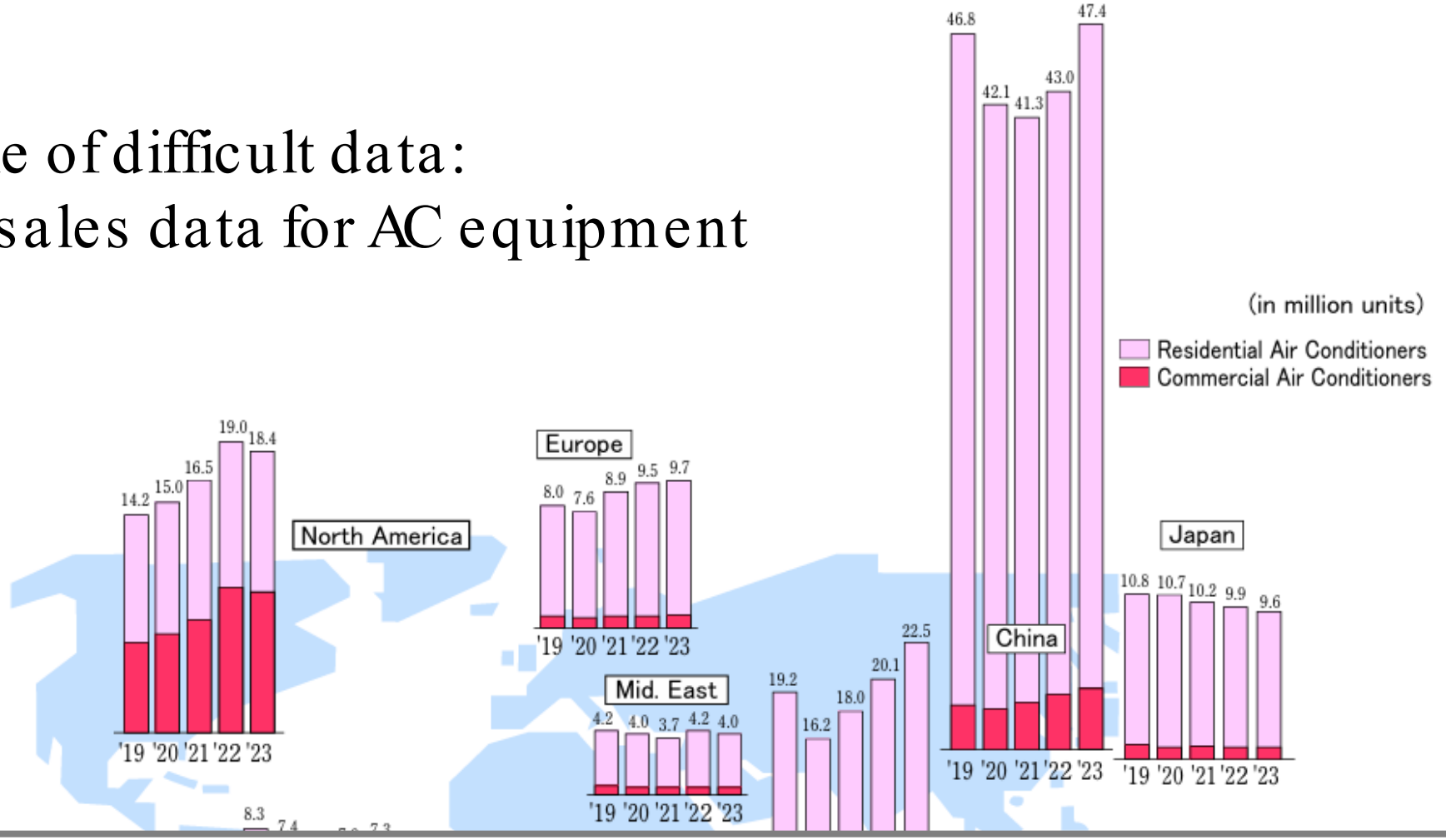
3 biggest challenges:

1) Lack of DATA
   - In particular, good stock data is very rare

2) Inconsistent DATA
   - "Number of units" vs "Cooling capacity, MW"
   - Inconsistent classification and definitions

3) Misleading DATA

Example of difficult data:
Global sales data for AC equipment



Room air conditioners consist of window-type air conditioners and small-sized single and multiple split-type air conditioners.

Commercial air conditioners consist of mainly medium- and large-sized split-type air conditioners, as well as remote condenser-type air conditioners, single package-type air conditioners and variable refrigerant flow (VRF) systems. Unitary air conditioners and unitary heat pumps that are the mainstream in the U.S. are included here.

Global Cooling Emissions Model Challenges

3 biggest challenges:

1) Lack of DATA
   - In particular, good stock data is very rare

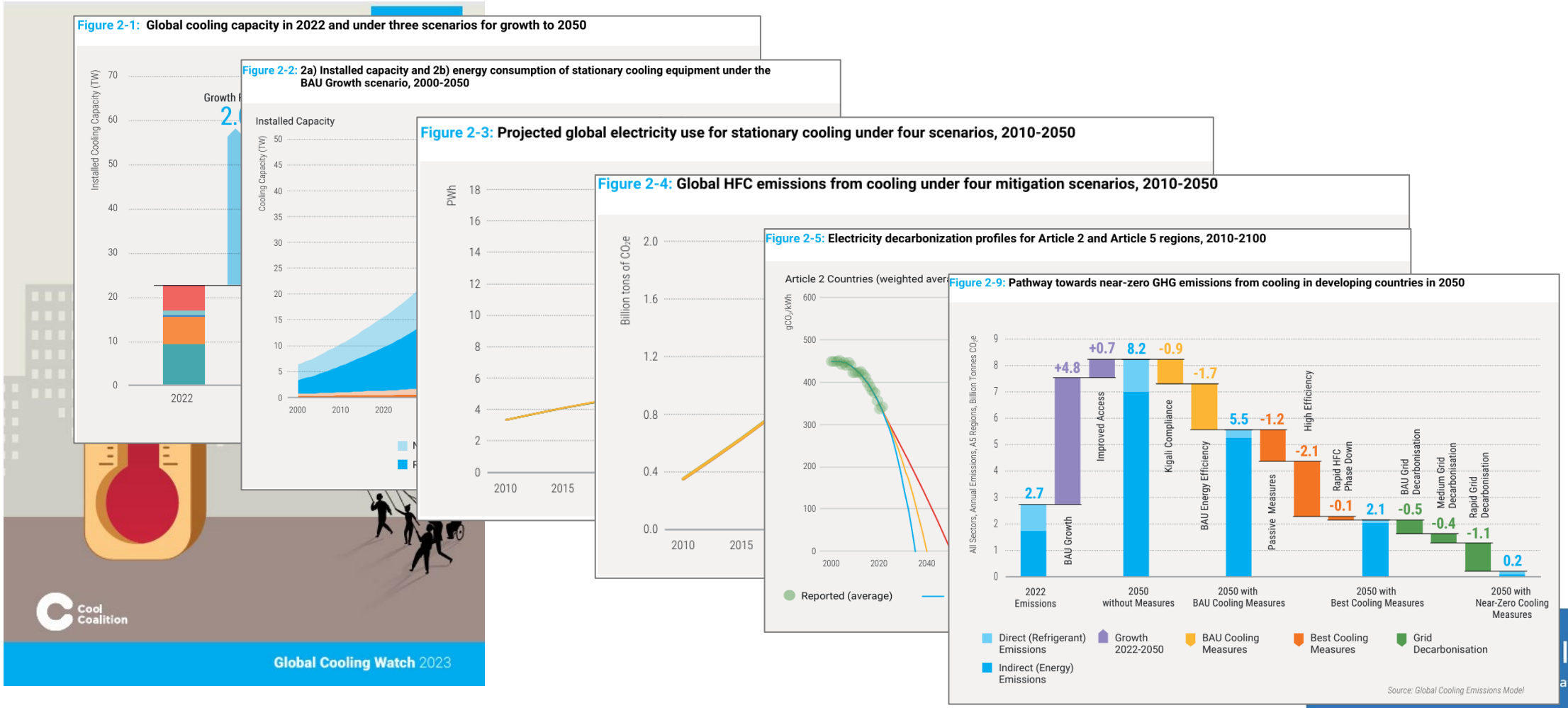
2) Inconsistent DATA
   - "Number of units" vs "Cooling capacity, MW"
   - Inconsistent classification and definitions
   - The CREED initiative is trying to improve this

3) Misleading DATA
   - Ambiguous claims for competing technologies, i.e. not comparing "like-for-like"
   - Claims that are very location or application specific

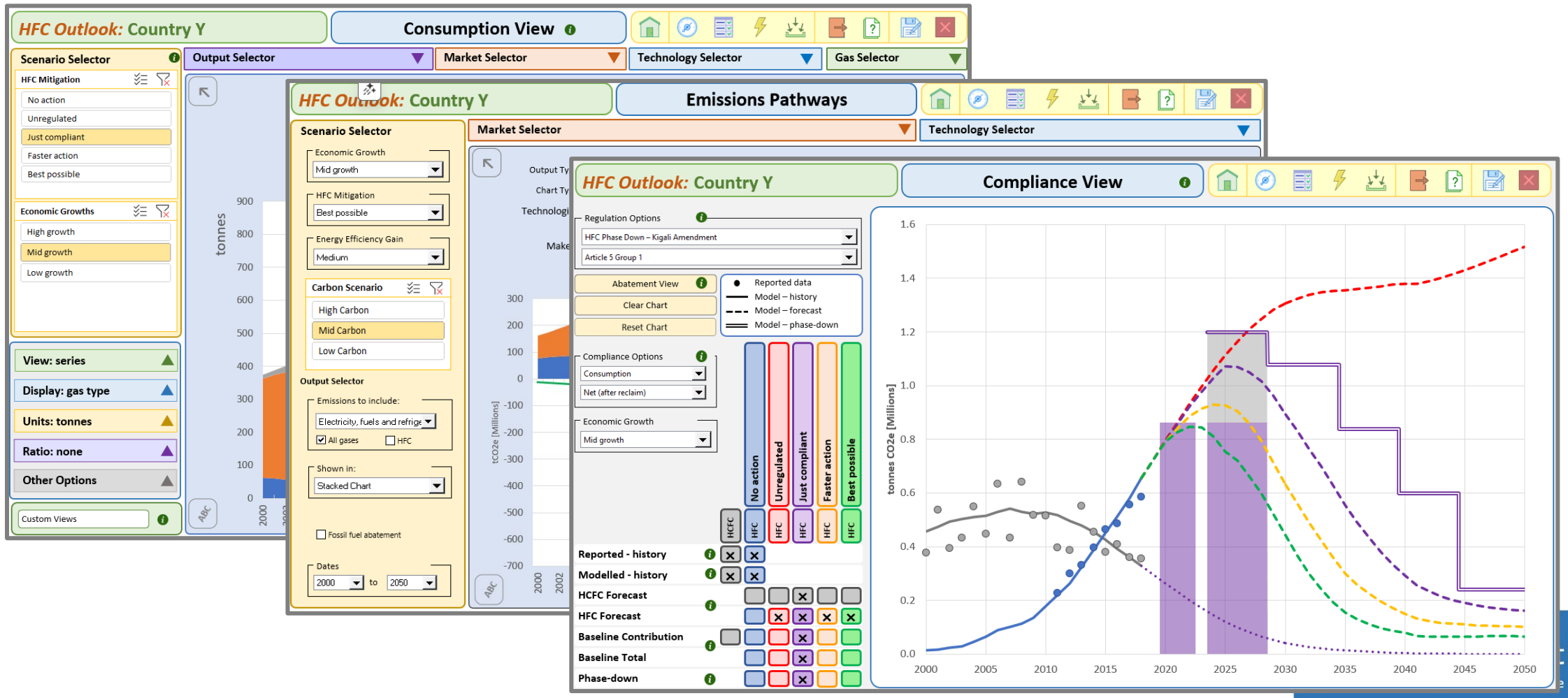
Global Cooling Emissions Model
Possible future developments

- Market granularity, for example
  - Agriculture / food processing / retail
  - Data centers
- Dynamic feedback, to give quicker assessment of e.g.
  - Lower refrigerant leakage
  - Faster adoption of Heat Pumps
  - Better building regulations
  - More heat recovery / renewable energy / etc.

Results used to support UNEP's Global Cooling Watch and Pledge



National "HFC Outlook" Models



Thank you

Ray Gluckman - ray@gluckmanconsulting.com

Tim Thurnham - timth@live.com

Gluckman Consulting

specialists in refrigeration and climate change