CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

Sharing of key findings on 'Study on HFC Consumption Trends in Article 5 Countries'

14 July 2022

Purpose of the study

The purpose of the study is to provide a profile of current and projected HFC consumption in Montreal Protocol Article 5 countries and outline opportunities for near-term control or reduction of HFC consumption to inform stakeholders on the potential benefits of an accelerated/optimized HFC phase-down and identify likely countries and sectors for near-term action. The study was conducted during Sep 2021- May 2022.

Coverage:

- A total of 144 Article 5 countries are included in the study. Of these, 89 are low-volume consuming (LVC) countries, and 55 are non-LVC countries.
- As of 1st May 2022, 94 Article 5 countries have either ratified or accepted the Kigali Amendment to the Montreal Protocol.
- As classified by the World Bank in 2021, 81 of the Article 5 countries belong to low-income or lower-middle-income groups and the remaining belong to either the high-income or upper-middle income group.

Study available at https://www.ccacoalition.org/en/resources/study-impacts-hfc-consumption-trends-article-5-countries

Methodology

Data availability:

- 104 Article 5 countries have submitted HFC consumption data in A7 2021 reporting (by May 2021).
- Limited data available for consumption per type of HFC and per sector
- Several large HCFC consuming countries including India, Saudi Arabia, Thailand have not yet reported HFC consumption data.

Data sources and estimation method:

- Various data sources have been consulted, including A7 data, CP report summary in MLF documents, TEAP reports, Kigali Implementation Plans preparation documents, old ODS alternatives survey (funded by MLF or CCAC), and country-specific papers on HFC consumption/emissions.
- If past HFC consumption data is not available or is not reliable, an HCFC proxy method is used to estimate HFC consumption. In this method, it is assumed that a country's HFC consumption share is in same proportion as in its share of HCFC consumption. This data is then compared with other sources (for the top 15 largest HCFC consumption countries) to arrive at the estimation of HFC consumption.

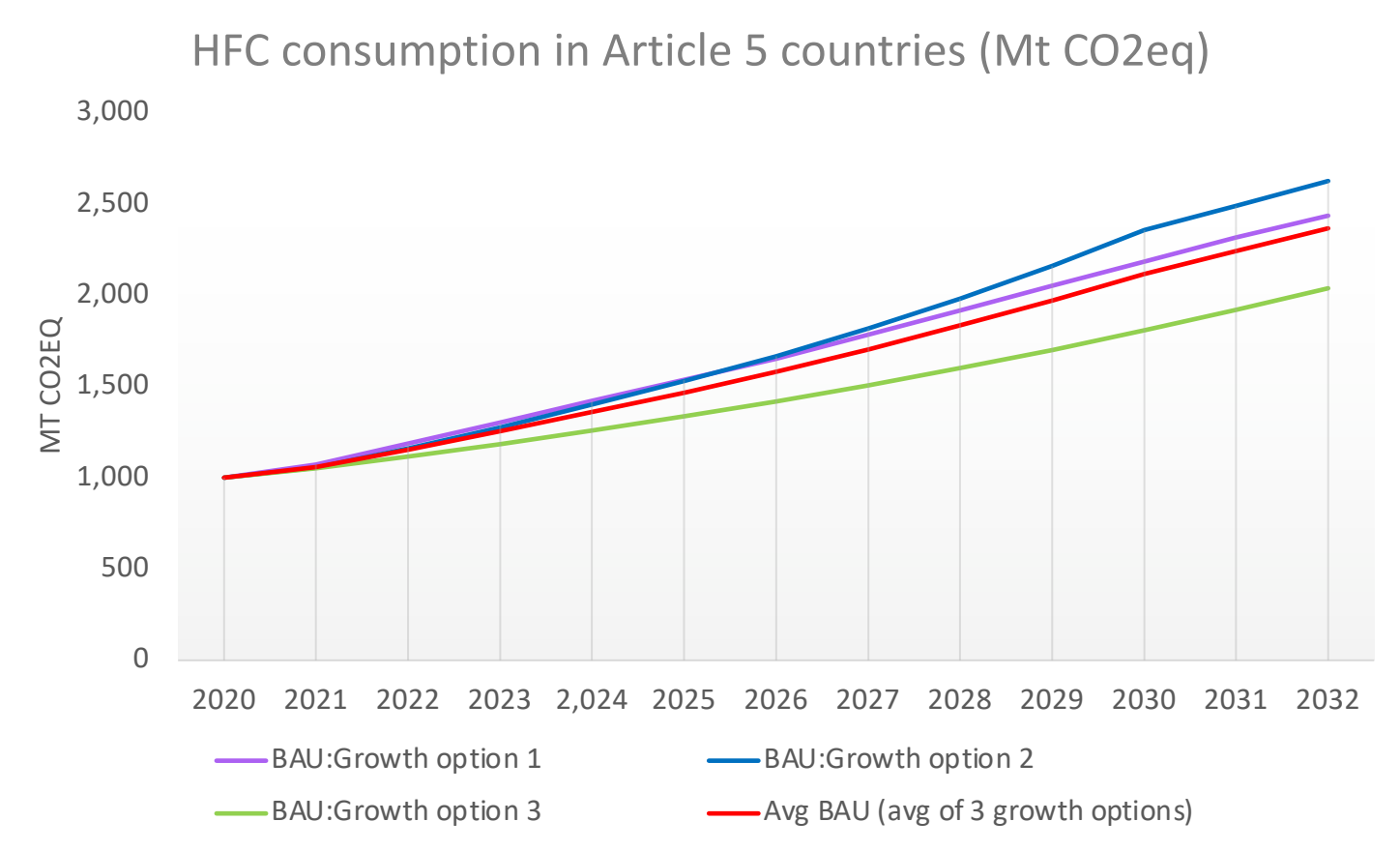
Methodology

Development of BAU growth projections:

- Estimation of HFC consumption for all 144 countries, as a first step, until year 2032, in business-as-usual scenarios (three possible growth trajectories are used to arrive at average BAU).
- Building consumption profiles per HFC type and per key sector based on the review of a range of information sources; for this exercise countries were divided into three categories:
    - 10 largest HCFC consuming countries (82.9% of the HCFC baseline)
    - 45 other non-low-volume-consuming (non-LVC) countries (15.1% of the HCFC baseline)
    - 89 LVC countries (2% of the HCFC baseline)
- Using above two in order to project HFC consumption for each Article 5 country, and aggregated consumption per sector and per HFC type, until year 2050

Key findings

- Total HFC consumption in Article 5 countries will grow from 1,001 Mt CO2eq in 2020 to 2,367 Mt CO2eq by 2032 under the BAU scenario(~ growth rate of 7.44% per annum).

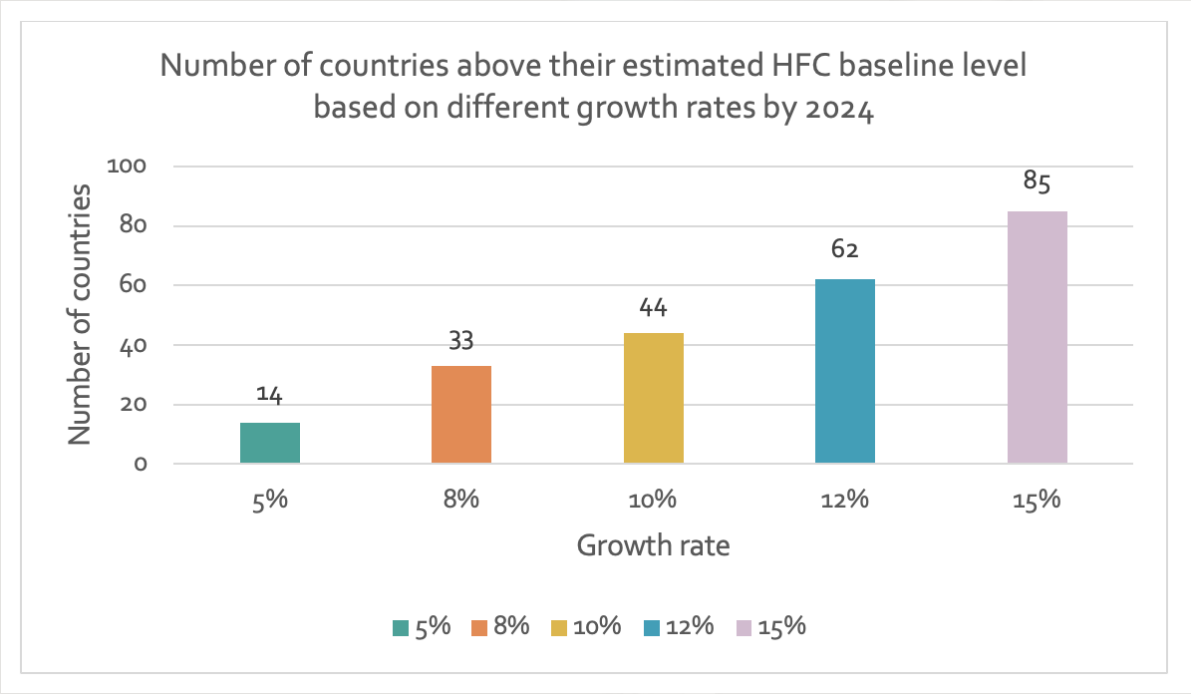


Key findings

- 28 Article 5 would be above the required freeze level by 2024 if action is not taken before that time to avoid and/or reduce consumption. If action is not taken by 2025 or 2026, an additional 27 Article 5 countries will fail to meet their freeze level.
- Of these total 55 countries, nearly 48 countries will exceed their freeze level by more than 10% by year 2026.
- Examining the ability for countries to meet the freeze until 2026 was considered relevant because even if project were initiated in 2022, they would likely take 3-4 years to achieve the reductions needed.

Key findings

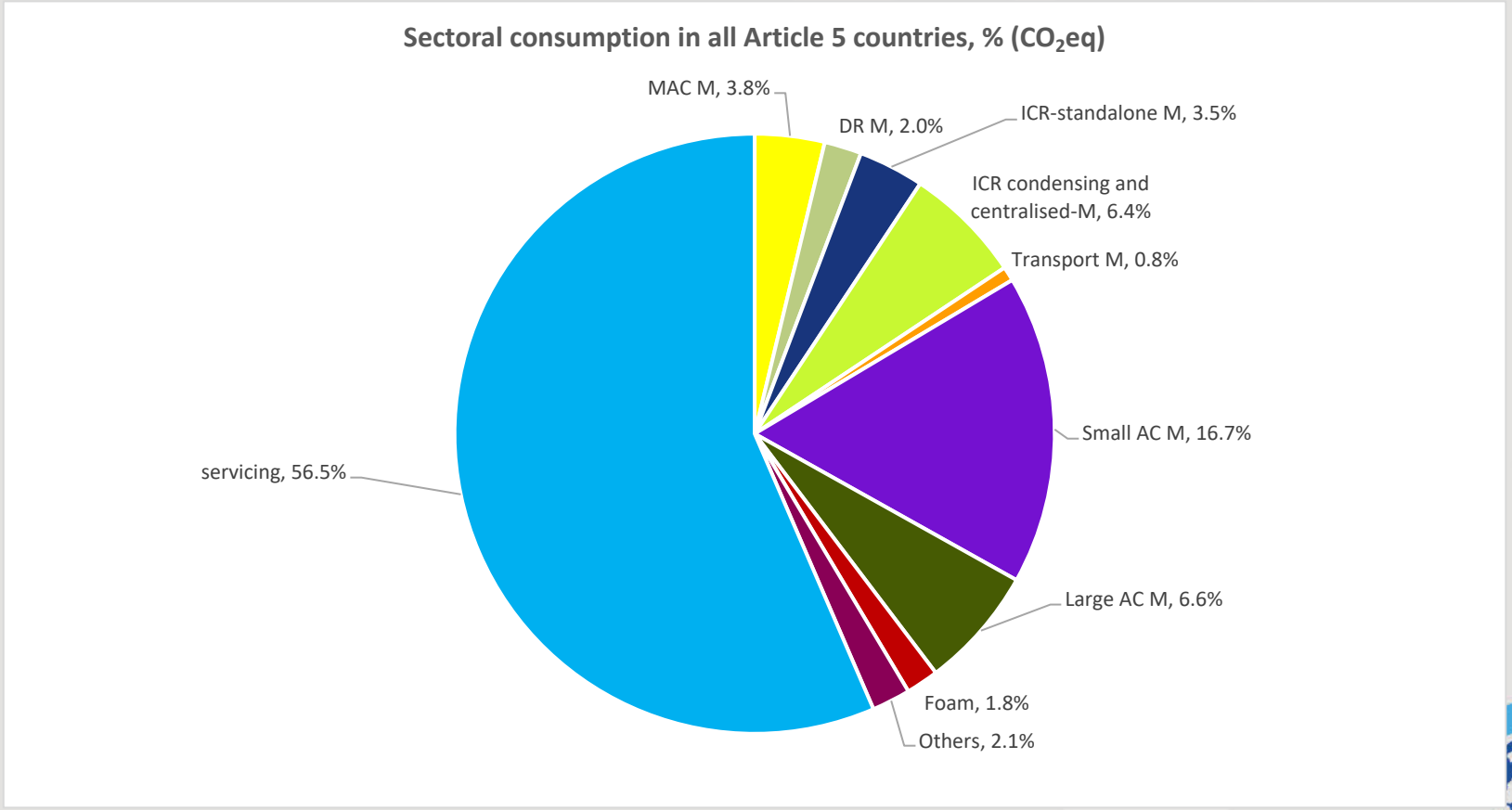
- HFC consumption growth during 2021-2024 has of course a major impact on how far or close countries will be from their baseline levels in the 2024-2026 period.



- Given a typical project implementation time frame of three to four years, this analysis points to the urgency of initiating HFC reduction projects and activities soon to ensure the compliance of many Article 5 countries with the 2024 freeze.

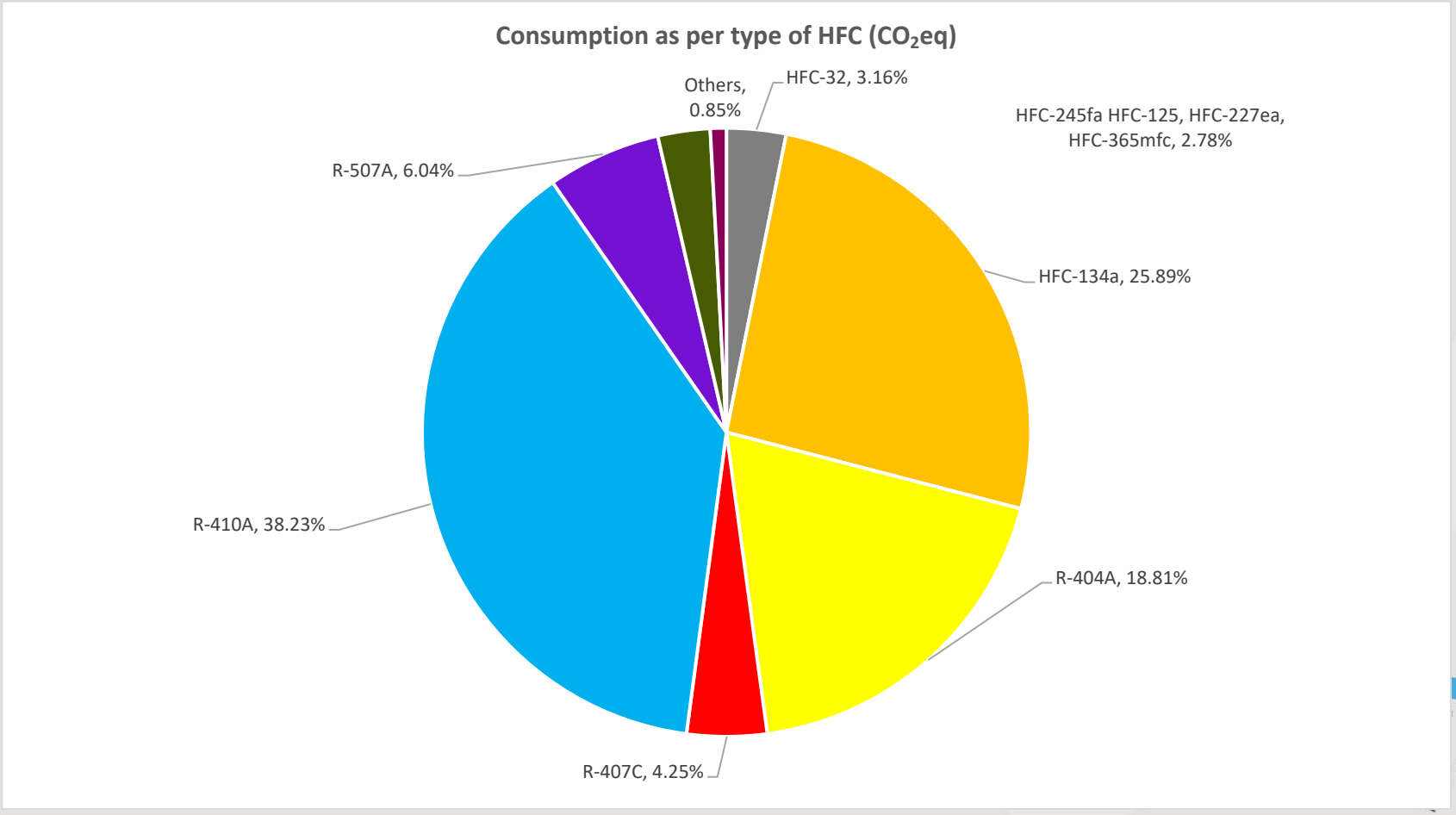
Key findings

- The servicing sector consumes more HFCs compared to manufacturing and local assembly sectors. Small AC manufacturing (16.7%), large AC manufacturing (6.6%), and ICR (condensing and centralized systems) manufacturing and local assembly (6.4%) sub-sectors contribute to nearly 68% of manufacturing related HFC demand.



Key findings

- In CO_2eq terms, HFC-410A (38.2%), HFC-134a (25.9%), and HFC-404A (18.8%) are the dominant HFCs used, with their primary use in RAC sector. HFC-32 has a share of 8.9% in mt terms but due to lower GWP its share in terms of CO_2eq is only 3.16%.



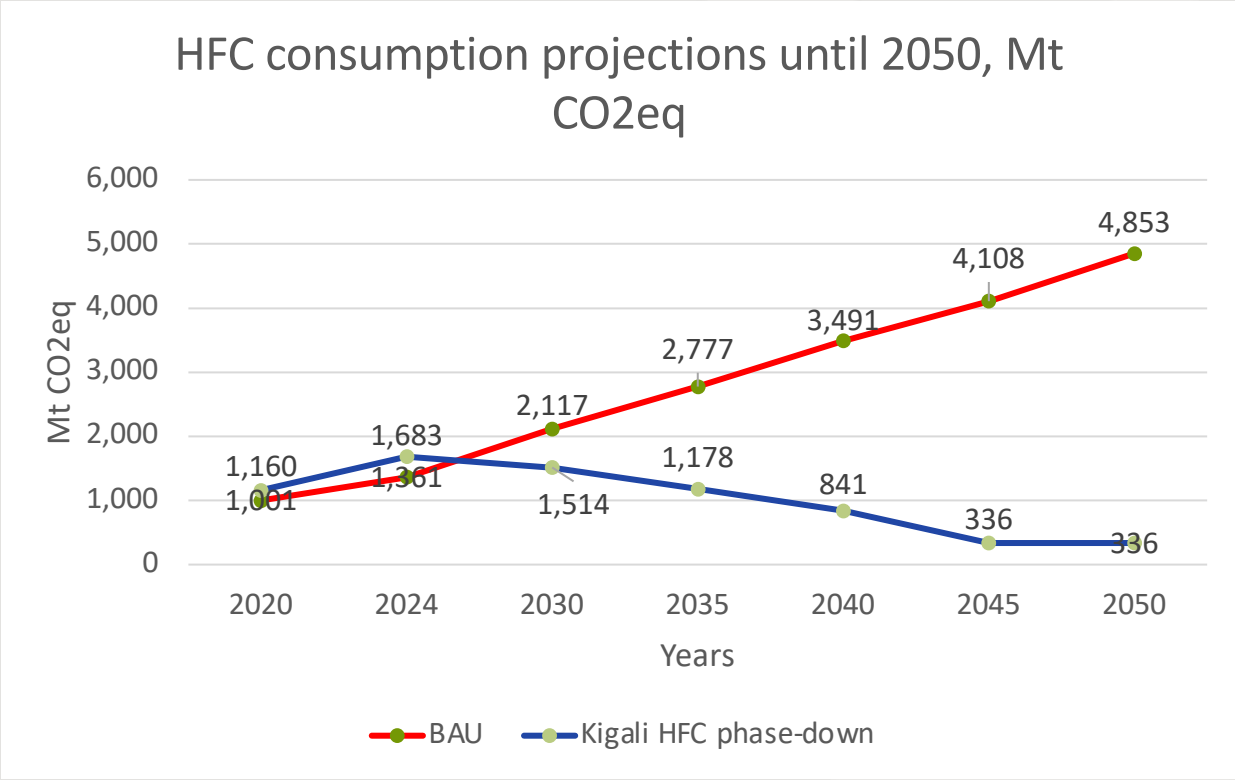
Potential near-term actions in countries where projected HFC consumption exceed baseline by 2026

Based on the sectoral analysis, actions that could be taken now by the 55 countries identified as at risk of exceeding baseline levels by 2026 were grouped as follows:

- Category 1 countries (10 highest consumers): complete phase-out of HFCs in domestic refrigeration, small commercial refrigeration and foams should be sufficient to meet near-term targets.
- Category 2 countries: in addition to above-mentioned actions, when possible, activities to reduce HFC consumption in local installation & assembly and servicing sector.
- Category 3 countries: immediate activities to reduce demand in servicing sector through policy measures, R&R, good practices and retrofits, combined with reductions of HFCs in local installation & assembly, when relevant.

Key findings

- Unabated growth in BAU will result in Article 5 HFC consumption growing up to 4,853 million (Mt) CO2eq range by the year 2050. In BAU, overall HFC consumption in Article 5 countries may exceed Kigali HFC phase-down goals by as early as the year 2025.



Mitigation Scenarios

Considering the sectoral distribution of HFCs in the different categories of countries, and information on the availability and GWP of alternatives for each sectors, two mitigation scenarios were developed:

- Mitigation scenario 1: would achieve aggregate HFC reductions in A5 countries that are the same or slightly exceed the HFC phase-down schedule under the Kigali Amendment for A5 countries
- Mitigation scenario 2: significantly exceed the phase-down schedule required under the Kigali Amendment on an aggregated basis.

Summary of measures in mitigation scenarios

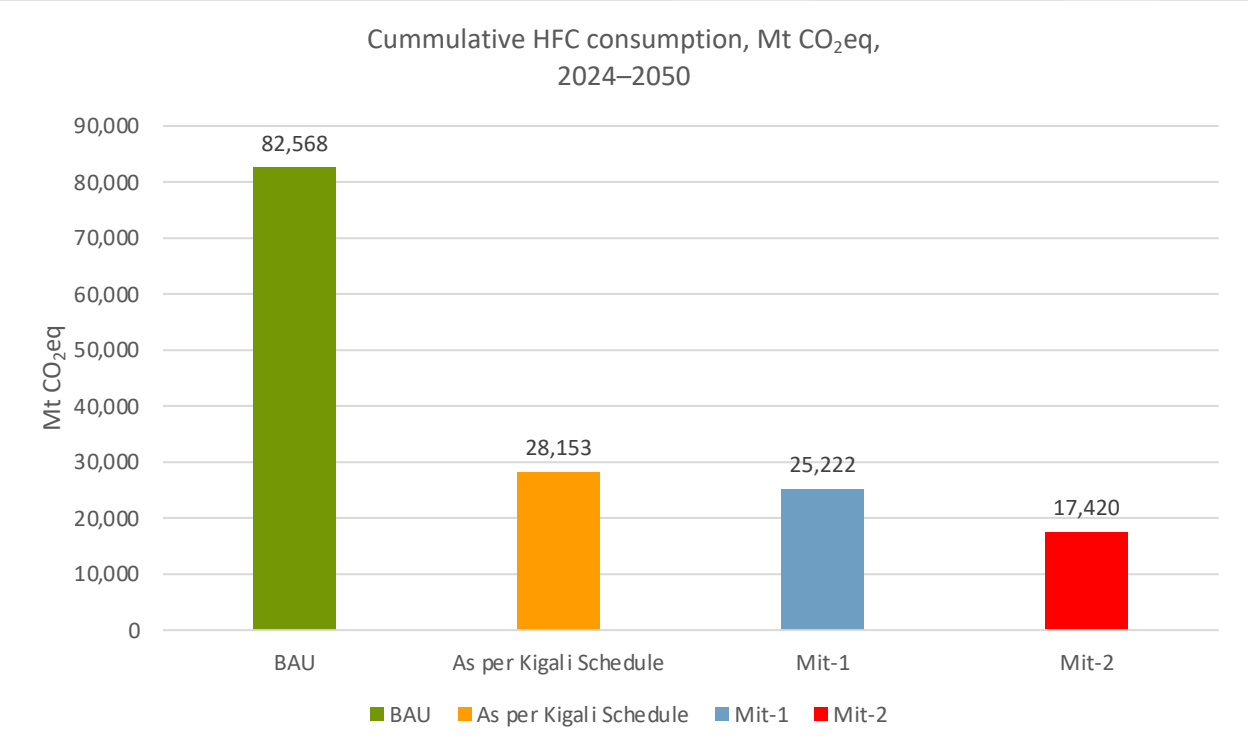
Sub-sector	Mit-1	Mit-2
Stationary AC manufacturing	Small AC: Conversion to HC-290 and HFC-32 between 2026 and 2032 to achieve an average GWP of 170 for the sub-sector. Post 2045, all HFC demand for small AC manufacturing will be based on zero or near-zero GWP options. Large AC: Conversion to HFC-32 and a mix of lower-GWP HFC/HFO blends between 2029 and 2040 to achieve an average GWP of 600 Chillers: conversion to HFO-1234yz and ammonia in centrifugal chillers (to achieve an average GWP of zero) and a mix of R-450A, R-513A and hydrocarbons in screw chillers (to achieve an average GWP of 300) between 2027 and 2030	Small AC: 170 Average GWP in small AC manufacturing by year 2028 (80% HC-290 and rest HFC-32 based). Post 2035, all HFC demand for small AC manufacturing will be based on zero or near-zero GWP options. Large AC: the study assumes that there will be appropriate standards allowing higher charge size of HC-290 to ensure even larger systems can move to alternatives mix of 600 by 2035 and 150 GWP by 2040. Chiller: sub-sector can move to average GWP of 300 between 2025-29 and 150 by 2042 onwards.
Domestic Refrigeration manufacturing	HC-600a in the manufacturing of new appliances between 2024 and 2028.	

Summary of measures in mitigation scenarios

Sub-sector	Mit-1	Mit-2
ICR local assembly and manufacturing	Stand-alone systems: conversion to HC based refrigerants for all manufacturing between 2026-30. Condensing units and centralized systems: average GWP of refrigerants for new systems in this sub-sector can reduced to 600 between 2028 and 2038 (a mix of R-744, ammonia, HC, and HFC/HFO blends) and 300 by 2045.	Stand-alone systems: conversion to HC based refrigerants for all manufacturing between 2024-28. Condensing units and centralized systems: average GWP of 600 between 2026-32 and GWP of 150 by 2038.
MAC manufacturing	Shift to HFO or CO2 between 2032-2042	Shift to HFO or CO2 between 2028-2032
Transport refrigeration manufacturing	Shift to refrigerant mix of GWP 700 between 2028-2035, and 150 by 2045	Shift to refrigerant mix of GWP 700 between 2027-2034, and 150 by 2040
Foam sector	Shift to hydrocarbons/HFOs as blowing agents between 2025-2029.	Phase-out is achieved by the year 2026.
RAC servicing	Servicing demand tapers down over a period of equipment life-time (10-20 years) due to decrease in uptake of low-GWP alternatives and usual retirement of old RAC equipment	Additional measures in RAC servicing sector may decrease servicing demand by additional 20% compared to Mit-1

Key findings

- Based on the results of the modelling of the two scenarios, the following figures show the cumulative HFC consumption in A5 countries between 2024-2050 under BAU, the Kigali Amendment and two mitigation scenarios considered in the study.



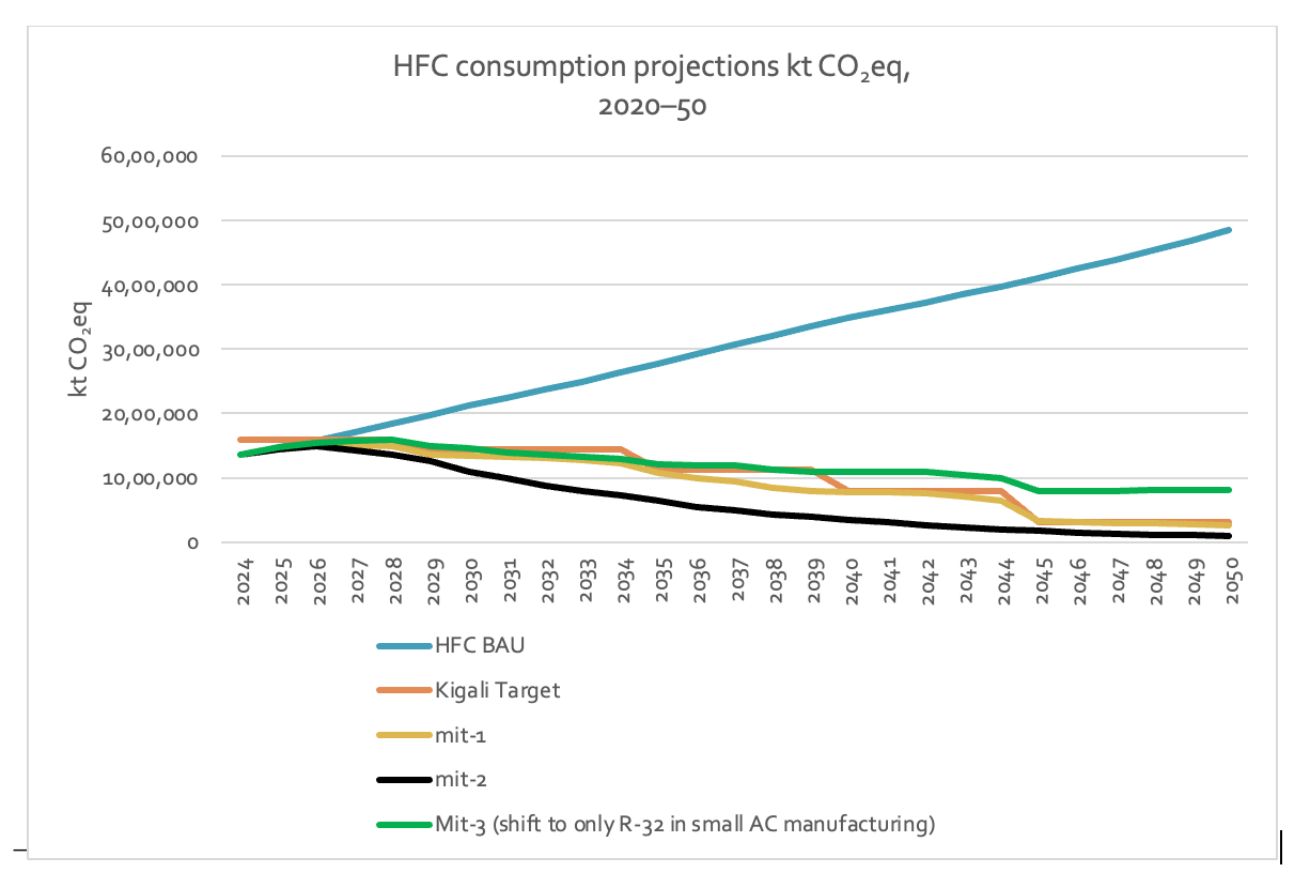
Key findings

- Mitigation scenarios developed in this study project additional savings of 2,931 MtCO2eq (Mit-1) and 10,733 MtCO2eq (Mit-2) of HFC cumulative consumption between 2024-50 compared to Kigali phase-down schedule.

HFC consumption (kt CO_2eq)	2024	2029	2032	2035	2040	2045	2050
BAU consumption	1,361	1,972	2,367	2,777	3,491	4,108	4,853
Kigali phase-down consumption	1,600	1,440	1,440	1,120	800	320	320
Mit-1 consumption	1,361	1,353	1,307	1,073	786	331	258
Mit-2 consumption	1,355	1,253	872	637	346	171	94
Reductions from BAU (to achieve a Kigali phase-down)[15]		532	928	1,657	2,691	3,788	4,533
Reductions from BAU to achieve Mit-1		619	1,060	1,704	2,705	3,777	4,595
Reductions from BAU to achieve Mit-2		718	1,495	2,140	3,144	3,937	4,759

Key findings

- According to the modelling performed under this study, a shift to HFC-32 in small AC will result in reductions of HFC consumption in the short-term. However, these reductions would not be sufficient to meet phase-down targets until a shift to much lower GWP (or near-zero options) is achieved.



Annex

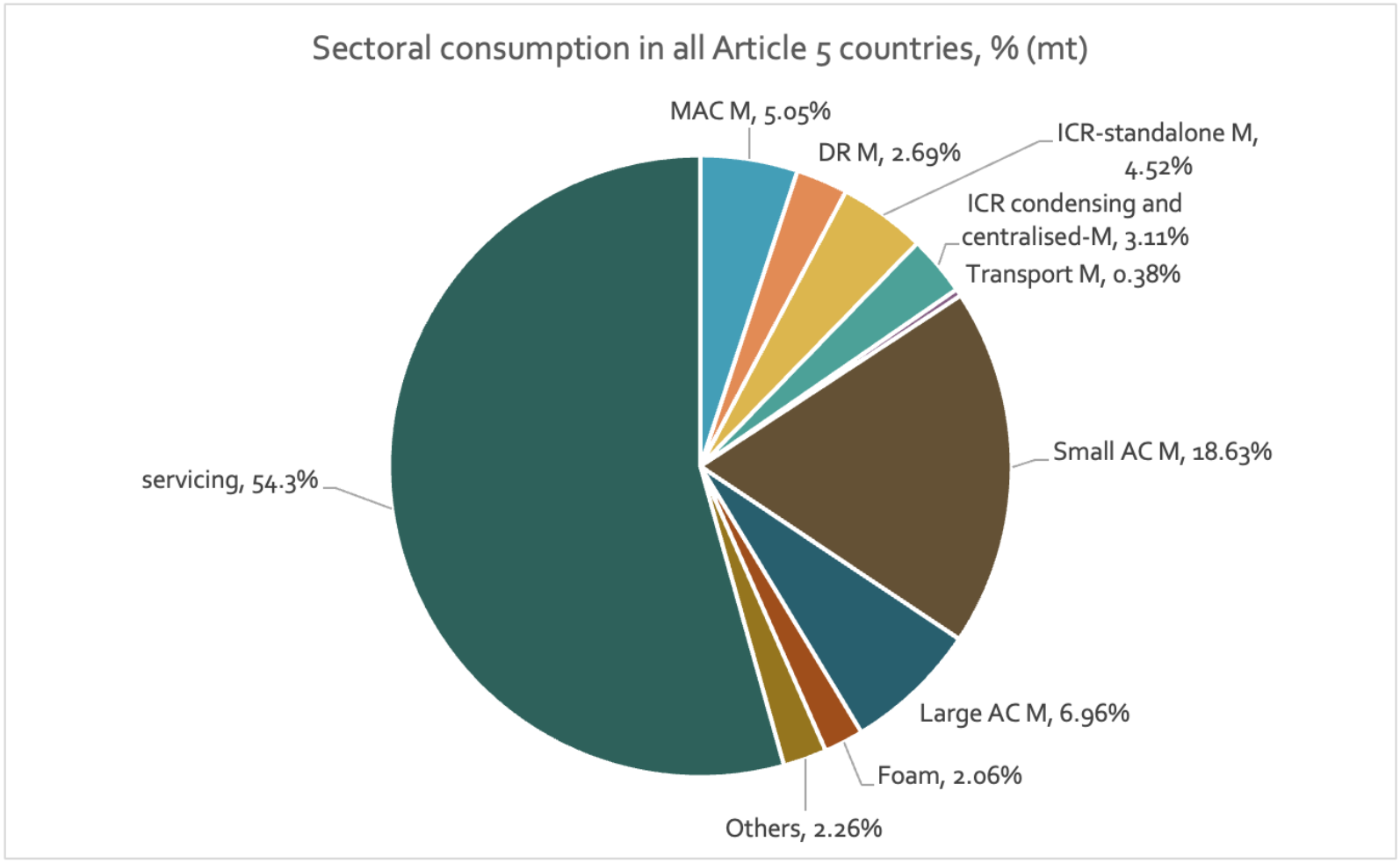
Countries in high priority list

Cook Islands	Sierra Leone	Guyana	Ecuador	Madagascar	Senegal
Gambia	Guinea Bissau	Costa Rica	Cambodia	Vanuatu	Benin
Seychelles	Somalia	Panama	Mongolia	Mozambique	Indonesia
Kiribati	El Salvador	Trinidad and Tobago	Grenada	Sudan	Colombia
Serbia	Saint Vincent and the Grenadines	Guatemala	Zambia	Viet Nam	Niger
Comoros	North Macedonia	Maldives	Armenia	Bangladesh	
Angola	Kyrgyzstan	Rwanda	Gabon	Honduras	
Uganda	Antigua and Barbuda	Nicaragua	Montenegro	Brazil	
Mauritania	Turkmenistan	Chile	Micronesia (Federated States of)	Bolivia	
United Republic of Tanzania	Suriname	Nauru	Mexico	Guinea	

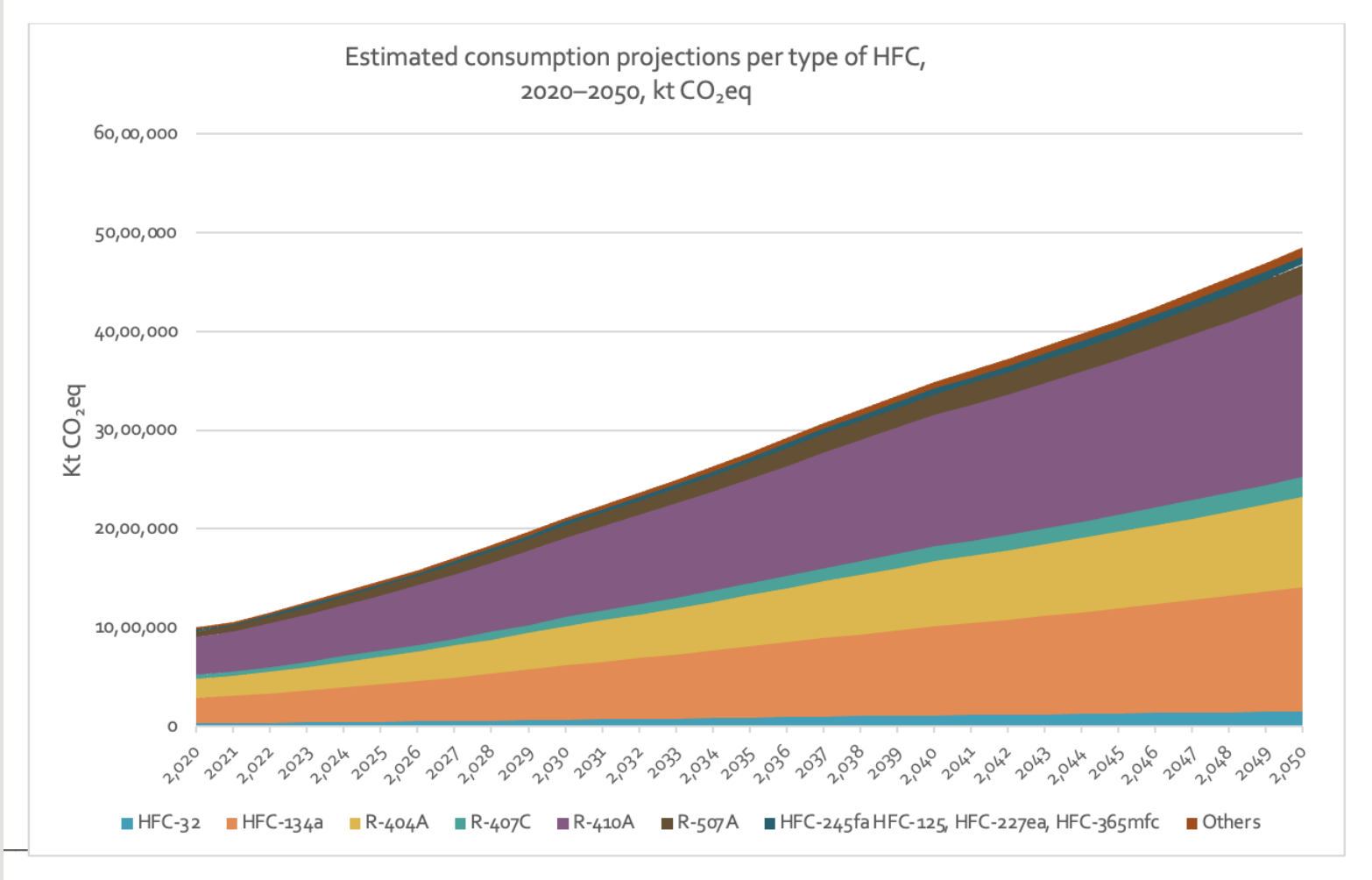
HCFC proxy method

a: reported HFC consumption data in Article-7 by 102 countries (average of 2019 and 2020), metric tonne (mt) CO_2eq b: per cent share of 102 countries of HCFC baseline c: total estimated HFC consumption of A5 countries = a/b mt CO_2eq
Country-specific HFC consumption (mt CO_2eq)= country's % share of HCFC baseline (CO_2eq) multiplied by c
HFC baseline: [average HFC consumption (2020-22 for Group 1 countries or 2024-26 for Group 2 countries) + 65% of HCFC baseline] in mt CO_2eq

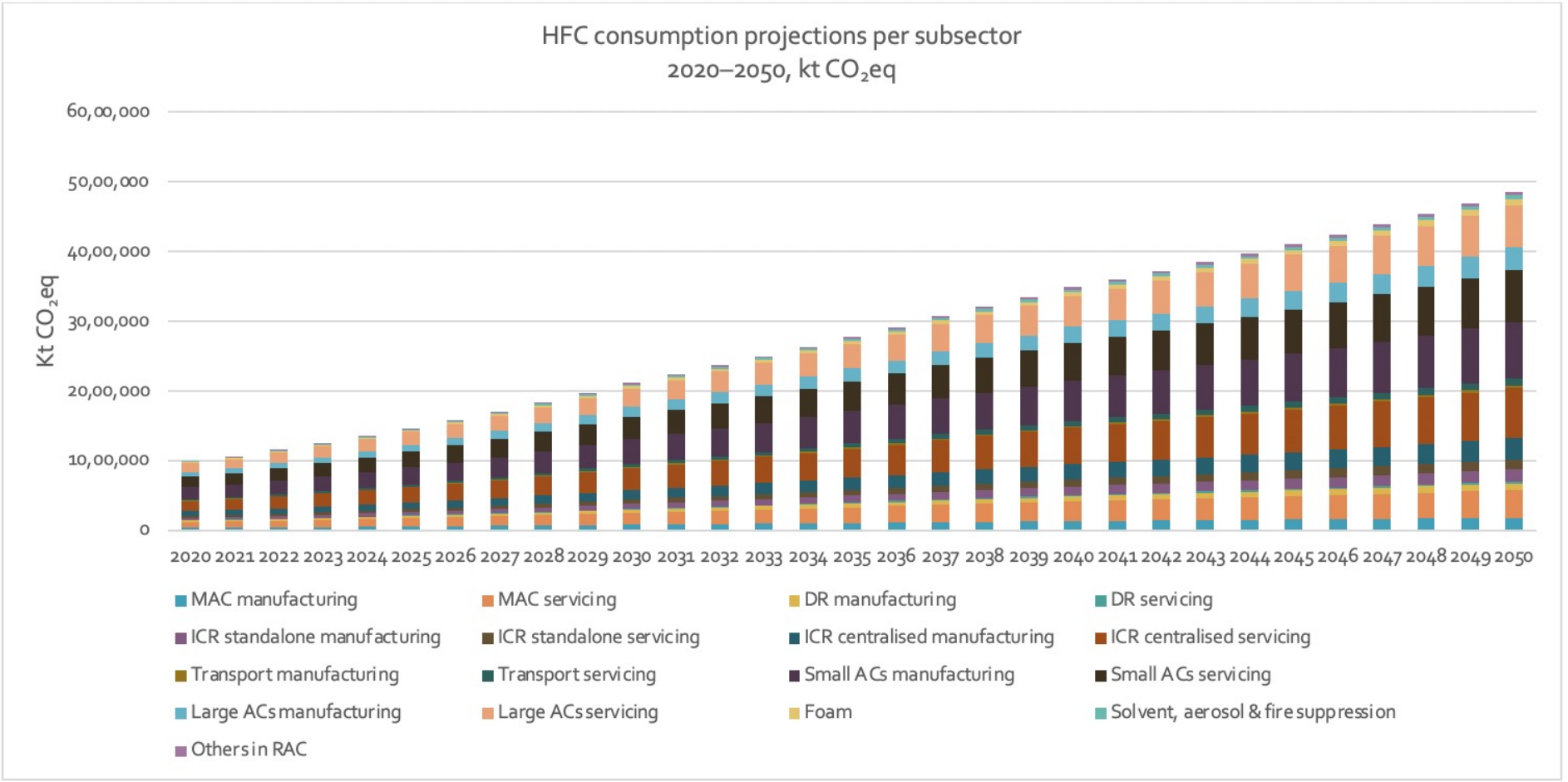
Sectoral consumption, % (mt)



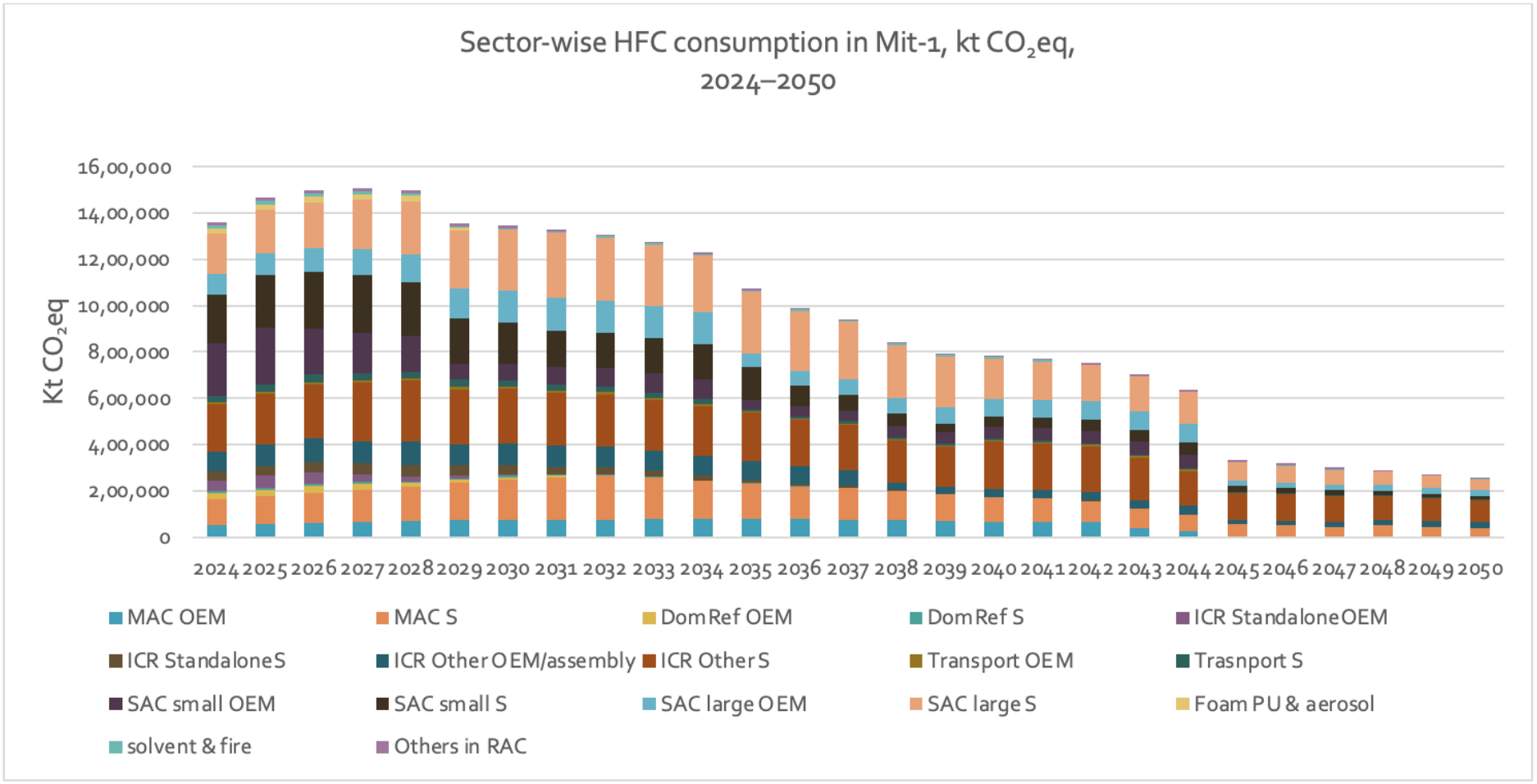
Estimated consumption projections per type of HFC, 2020-2050, Kt CO_2eq



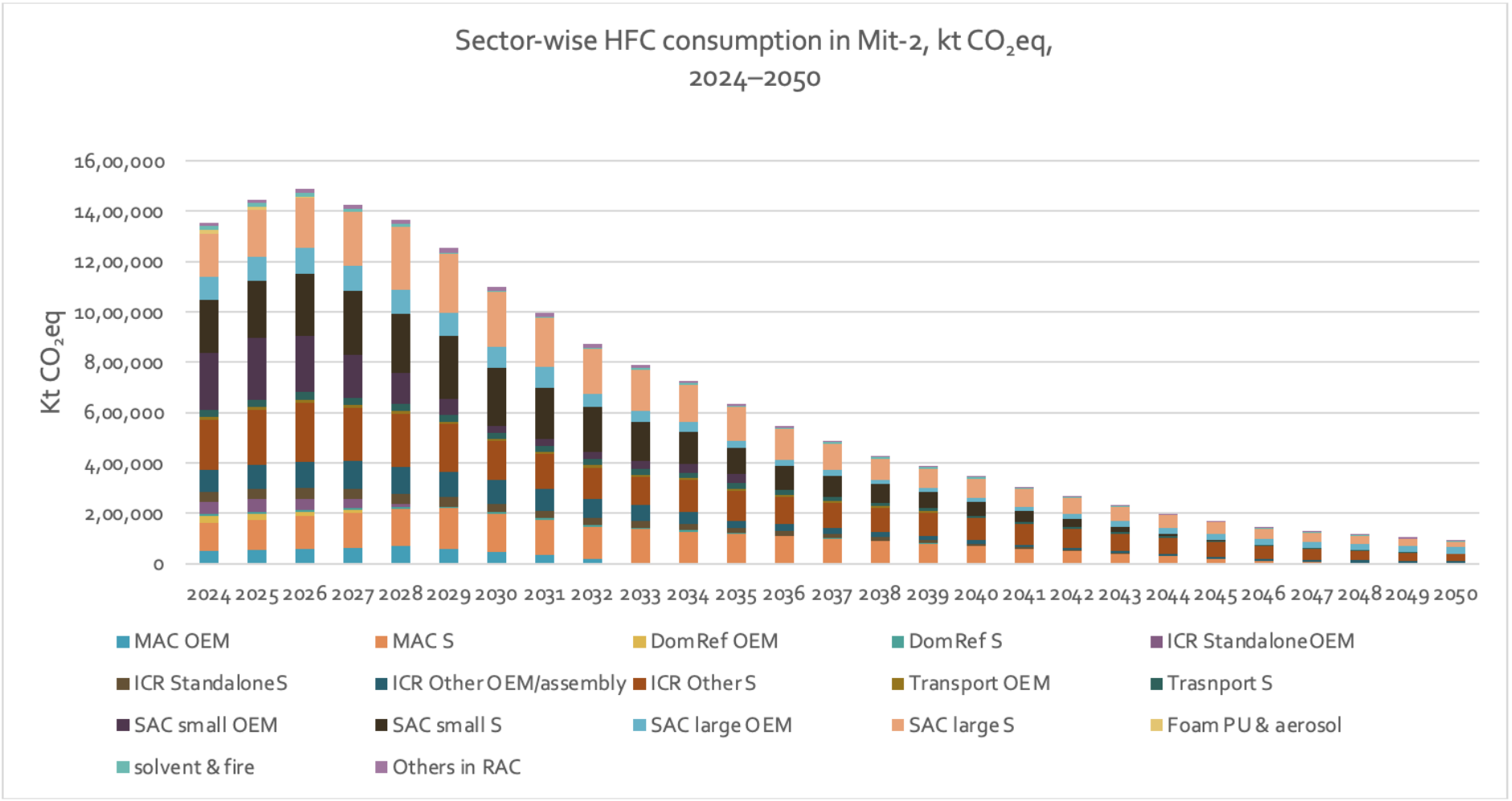
Estimated consumption projections per sub-sector, 2020-2050, Kt CO_2eq



Sector-wise HFC consumption in Mit-1



Sector-wise HFC consumption in Mit-2



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THANK YOU !