

Appendix A: Refrigeration and Air Conditioning (RefAC) Disaggregation

The Refrigeration and Air Conditioning (RefAC) sector is the largest contributor to global HFC emissions of all sectors. Within the RefAC sector, HFC emission estimates can be disaggregated into nine end-use sector categories: retail food, cold storage and industrial process refrigeration, refrigerated transport, commercial air conditioning, chillers, residential air conditioning, motor vehicle air conditioners (MVACs) and other appliances.

Commercial refrigeration includes retail food refrigeration, cold storage, and industrial process refrigeration. Commercial refrigeration systems are used in supermarkets, warehouses, ice rinks, industrial plants, and other commercial establishments. HFCs most commonly used in commercial refrigeration include HFC-134a, R-404A, R-407A, R-407C, R-410A, and R-507. Transport refrigeration (e.g., refrigerated vans, trucks, railcars, ships, and intermodal containers) mainly uses HFC-134a and R-404A refrigerants. Other appliances, which include refrigerators and freezers used at residential establishments (e.g., household refrigerators and wine coolers), predominantly use HFC-134a as a refrigerant.

Commercial air conditioning systems provide comfort cooling in commercial buildings and building complexes (e.g., hotels, offices, hospitals, and universities). These systems include chillers (e.g., with centrifugal, screw, and scroll compressors), ducted, commercial, split and packaged air conditioners, which mainly use HFC-134a, R-407C, and R-410A. Residential air conditioning systems provide comfort cooling in residential spaces ranging from single rooms (e.g., window-mounted, portable, and through-the-wall units) to homes (e.g., ducted and split units) and are consistently the highest global HFC emissions source through 2030. HFCs most commonly used in residential air conditioning include R-410A and R-407C blends. MVACs use HFC-134a to cool the passenger compartment of passenger cars and other light and heavy-duty vehicles (i.e., trucks, buses/coaches, trailers, and railcars).

The specific breakdowns of HFC emissions (MMTCO₂e) by region and their relative contribution for the RefAC sector are shown below.

Sector	U.S. and Other Developed ^a	EU	Developing
2015			
Chillers	4.32	1.17	10.57
Retail Food	66.41	31.30	38.76
Cold Storage and IP	16.05	4.35	4.73
Commercial AC	3.82	1.03	9.33
Residential AC	63.26	17.15	154.62
Refrigerated Transport	9.95	2.70	3.14
Other Appliances	1.90	0.37	14.16
MVACs	60.51	13.88	54.61
2020			
Chillers	4.75	0.85	13.57

Sector	U.S. and Other Developed ^a	EU	Developing
Retail Food	62.70	18.53	71.44
Cold Storage and IP	24.80	4.21	9.39
Commercial AC	6.21	1.07	17.71
Residential AC	104.26	18.05	297.53
Refrigerated Transport	14.07	2.44	4.60
Other Appliances	2.01	0.11	16.89
MVAC	38.39	4.25	73.44
2025			
Chillers	4.84	0.53	13.81
Retail Food	66.30	9.20	115.40
Cold Storage and IP	34.21	2.84	15.46
Commercial AC	8.98	0.83	25.62
Residential AC	157.54	14.10	449.54
Refrigerated Transport	18.02	1.68	6.04
Other Appliances	1.57	-	19.18
MVAC	22.74	0.81	89.31
2030			
Chillers	6.39	0.58	21.71
Retail Food	62.98	6.50	158.83
Cold Storage and IP	45.57	2.69	20.70
Commercial AC	9.86	0.70	33.49
Residential AC	172.11	9.63	584.23
Refrigerated Transport	22.58	1.59	7.10
Other Appliances	1.55	-	21.04
MVAC	18.08	0.08	105.23
2035			
Chillers	5.93	0.64	20.18
Retail Food	60.14	6.48	157.41
Cold Storage and IP	54.47	3.20	20.52
Commercial AC	9.71	0.72	33.03
Residential AC	170.61	7.61	580.49
Refrigerated Transport	25.49	1.88	7.04
Other Appliances	0.11	-	20.85
MVAC	4.90	0.09	104.28
2040			
Chillers	5.11	0.82	18.98

Sector	U.S. and Other Developed ^a	EU	Developing
Retail Food	63.11	8.08	175.37
Cold Storage and IP	59.40	3.89	22.86
Commercial AC	9.91	0.87	36.80
Residential AC	175.07	4.88	650.23
Refrigerated Transport	27.73	2.44	7.84
Other Appliances	0.11	-	23.23
MVAC	1.29	0.11	116.18
2045			
Chillers	3.80	0.84	14.79
Retail Food	66.30	8.43	186.76
Cold Storage and IP	63.70	3.86	24.35
Commercial AC	10.11	0.89	39.31
Residential AC	179.42	4.80	697.78
Refrigerated Transport	29.39	2.57	8.35
Other Appliances	0.12	-	24.74
MVAC	1.35	0.12	123.73
2050			
Chillers	3.75	0.86	15.02
Retail Food	69.67	8.72	201.77
Cold Storage and IP	68.26	4.08	26.30
Commercial AC	10.60	0.91	42.53
Residential AC	188.16	4.96	754.76
Refrigerated Transport	31.08	2.68	9.02
Other Appliances	0.12	-	26.73
MVAC	1.42	0.12	133.68

^a Excluding the EU