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HFC-free stationary air conditioning is feasible

This fact sheet provides current information on phasing out hydrofluorocarbons (HFCs) in stationary air conditioning in the European Union. It is intended to inform revisions to the F-Gas Regulation, which are currently under consideration. The term "stationary air conditioning" covers several applications including moveable systems, split systems, multi-split systems, rooftop systems, displacement chillers, heat pumps and centrifugal chillers.

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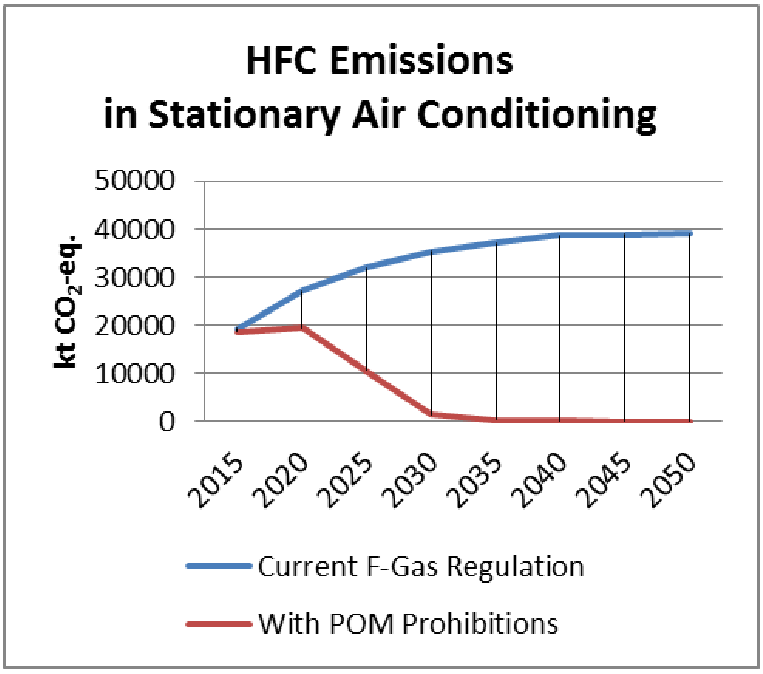
Emission trends and alternatives

HFC emissions from stationary air conditioning will significantly undermine climate objectives unless action is taken soon. Even assuming full implementation of the F-Gas Regulation, HFC emissions from this sector will rise steadily over time without additional measures.[1] With the average lifetime of the equipment ranging from 10 to 25 years, there is a need to prevent new HFC-based equipment from being placed on the market in order to achieve climate targets in 2030 and beyond.[2]



Several recent studies have identified technically feasible and safe alternatives already in use in the European Union.[3] The alternatives vary for each subsector, but mostly rely on natural refrigerants such as propane, isobutane, ammonia and carbon dioxide.[4] A recent European Commission-funded study analyzed the market penetration of alternatives and determined that, with only small derogations for discrete applications, HFC-based equipment can be banned by 2020 in stationary air conditioning with the sole exception being centrifugal chillers, which can be banned sometime before 2030.[5] These additional measures would prevent over 998 Mt/CO_2-eq. emissions through 2050,[6] resulting in significant reductions of HFC emissions on a timescale responsive to climate science.

Energy efficiency

HFC-free alternatives for each sub-sector exist with equal or greater energy efficiency compared to the HFC-based equipment.[7] This is particularly relevant in light of the EU Energy Efficiency Plan, which sets out a 2020 target of 20% reduction in energy consumption compared to projections.[8] Increased energy efficiency decreases reliance on fossil fuels and reduces running costs for consumers.

* The Environmental Investigation Agency (EIA) is an independent campaigning organisation committed to bringing about change that protects the natural world from environmental crime and abuse. For more information, contact ukinfo@eia-international.org.

Cost effectiveness

On a CO_2-equivalent basis, alternatives are very cost-effective. Banning the use of HFCs in this sector with placing on the market (POM) prohibitions would achieve significant GHG reductions at much lower costs than containment and recovery measures for all subsectors except heat pumps, as demonstrated in Table 1.[9]

By comparison, the Stern Review suggests that the social cost of carbon today is approximately €64.5/t CO_2-eq.,[10] a figure well above the abatement costs in most sectors. For heat pumps, although costs are indeed higher on a CO_2-eq. basis, several HFC-free alternatives exist that will put a downward pressure on prices in the future once the correct market signals are established. Switching to HFC-free alternatives is sound public policy.

Table 1: Effectiveness of Placing HFC-Based Equipment and Alternatives on the Market

Subsector	Containment and Recovery		POM Prohibition	
	GHG Emissions Abated	Abatement Cost (t/CO_2-eq.)	GHG Emissions Abated	Abatement Cost (t/CO_2-eq.)
Moveable Systems	35.1%	€ 45.4	99.9%	€ 8.8
Split Systems	29.1%	€ 45.4	99.8%	€ 19.0
Multi-Split/VRF Systems	30.7%	€ 202.6	99.7%	€ 13.1
Rooftop Systems	30.5%	€ 247.7	99.8%	€ 8.1
Displacement Chillers	36.7%	€ 75.5	99.9%	€ 5.8
Centrifugal Chillers	38.4%	€ 36.4	99.5%	€ 11.0
Heat Pumps	28.7%	€ 27.7	99.8%	€ 130.1

From an end-user perspective, consumers can expect to save money over the lifetime of alternatives.[11] Because HFC-based equipment has achieved significant economies of scale, upfront investment costs tend to be lower. But HFC-based equipment generally has higher annual running costs due to increased energy consumption, costs of refills and regulatory compliance.[12] For these reasons, most HFC-free alternatives more than make up the higher upfront investment costs during their 10- to 25-year lifetime through lower annual running costs, resulting in end-user cost savings. For those that do not payback, the incremental costs are insignificant. Nevertheless, to overcome any barriers to adoption resulting from higher upfront investment costs, especially for small-and medium-sized enterprises (SMEs), Member States can design support schemes to reduce upfront costs and promote taxes on HFC use.

Table 2: Costs to End Users of HFC-Based Equipment and HFC-Free Alternatives

	Refrigerant	Upfront Costs	Annual Costs	Lifetime Costs	Cost Differential
Moveable Systems	**HFC-410a**	**€ 311**	**€ 142**	**€ 1,733**	---
	Propane	€ 301	€ 140	€ 1,698	- € 35
	CO_2	€ 365	€ 140	€ 1,762	+ € 29
Split Systems	**HFC-410a**	**€ 773**	**€ 216**	**€ 2,934**	---
	Propane	€ 743	€ 210	€ 2,845	- € 89
	CO_2	€ 947	€ 210	€ 3,050	+ € 116
Mult-Split & VRF Systems	**HFC-410a**	**€ 9,703**	**€ 3,557**	**€ 55,939**	---
	Propane	€ 11,980	€ 3,361	€ 55,670	- € 269
	CO_2	€ 10,884	€ 3,431	€ 55,486	- €452
Rooftop Systems	**HFC-410a**	**€ 10,158**	**€ 6,471**	**€ 74,872**	---
	Propane	€ 11,608	€ 6,300	€ 74,612	- € 260
	CO_2	€ 11,342	€ 6,339	€ 74,733	- € 138
Displacement Chillers	**HFC-407c**	**€ 22,750**	**€ 10,024**	**€ 143,032**	---
	Propane	€ 23,225	€ 9,805	€ 140,885	- € 2,147
	Ammonia	€ 30,482	€ 9,119	€ 139,912	- € 3,120
	CO_2	€ 28,580	€ 9,858	€ 146,876	+ € 3,844
Centrifugal Chillers	**HFC-134a**	**€ 146,300**	**€ 141,735**	**€ 3,689,678**	---
	Propane	€ 148,575	€ 140,763	€ 3,667,650	- € 22,028
	Water Vapor	€ 166,602	€ 140,840	€ 3,687,612	- € 2,066
Heat Pumps	**HFC-410a**	**€ 7,036**	**€ 1,844**	**€ 34,699**	---
	Propane	€ 7,356	€ 1,840	€ 34,953	+ € 254
	CO_2	€ 7,850	€ 1,840	€ 35,449	+ € 750
	Isobutane	€ 7,496	€ 1,840	€ 35,093	+ € 394

Policy recommendations

Policymakers should revise Annex II of the F-Gas Regulation to include POM prohibitions on HFCs in stationary air conditioning starting in 2020 for all subsectors with the exception of centrifugal chillers, which should start in 2025:[13]

Fluorinated Greenhouse Gases	Products and Equipment	Date of Prohibition
Fluorinated GHG gases GWP >15	Moveable Systems	1 January 2020
Fluorinated GHG gases GWP >15	Split Systems	1 January 2020
Fluorinated GHG gases GWP >15	Multi-Split/VRF System	1 January 2020
Fluorinated GHG gases GWP >15	Rooftop Systems	1 January 2020
Fluorinated GHG gases GWP >15	Chillers (Displacement)	1 January 2020
Fluorinated GHG gases GWP >15	Heat Pumps	1 January 2020
Fluorinated GHG gases GWP >15	Centrifugal Chillers	1 January 2025

In addition, in the years before the POM prohibition takes effect, the European Union should consider a gradual phase-down of HFC-based equipment through quantitative limits on new units placed on the market. This will promote the progressive uptake of alternatives in advance of the POM prohibition, providing certainty of investment and preventing market disruptions.

Environmental Investigation Agency
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[1] Öko-Recherche *et al.*, *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report* (September 2011)[hereinafter "Öko-Recherche Study"], Annex VI, pp. 307-324 (chart produced from data provided by Öko-Recherche).
[2] *See* European Commission, *Commission Staff Working Document – Impact Assessment – Accompanying Document to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Roadmap for Moving to a Competitive Low Carbon Economy in 2050*, Sec(2011) 289 final (8 March 2011).
[3] *See e.g.* Öko-Recherche Study; Umweltbundesamt, *Avoiding Fluorinated Greenhouse Gases: Prospects for Phasing Out* (June 2011, English Version); European Commission, *Report from the Commission on the Application, Effects and Adequacy of the Regulation on Certain Fluorinated Greenhouse Gases (Regulation (EC) No 842/2006)* (September 2011).
[4] Öko-Recherche, Study, Annex V, pp. 253-259 and Annex VI, pp. 307-324.
[5] Öko-Recherche, Study, pp. 262-264, 292.
[6] *See* Öko-Recherche Study, Annex V, pp. 253-259 and Annex VI, pp. 307-324 (figure derived from data provided by Öko-Recherche).
[7] Öko-Recherche, Study, Annex V, pp. 253-259.
[8] European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Energy Efficiency Plan 2011* (8 March 2011), SEC (2011) 280 final, p. 2.
[9] Öko-Recherche, Study, Annex V, pp. 253-259 (abatement cost of containment and recovery determined by dividing the additional annual cost of containment and recovery measures by the GHG reductions achieved from those measures; cost of POM prohibitions already outlined for each subsector).
[10] Stern, N. *et al.*, *The Economics of Climate Change: The Stern Review*, Cambridge University Press (2007).
[11] Öko-Recherche, Study, Annex V EU Sector Sheets, pp. 248-249.
[12] Öko-Recherche, Study, Annex V, pp. 253-259 (chart produced from Öko-Recherche data; upfront costs represent the initial cost of the hardware plus cost of first fill).
[13] Some subsectors may need to rely on unsaturated HFCs—also referred to as hydrofluoro-olefins (HFOs) with a GWP less than 15—to meet their POM prohibition dates. But the European Commission should periodically review whether a full POM prohibition on all HFCs is appropriate given the uncertainties in lifecycle HFC emissions associated with HFO production and the persistent toxicity of their breakdown chemicals in the environment.