European Commission

The EU case: Developing a domestic HFC phase-down with global ambitions

EPEE Side event, OEWG, Paris, 15 July 2014

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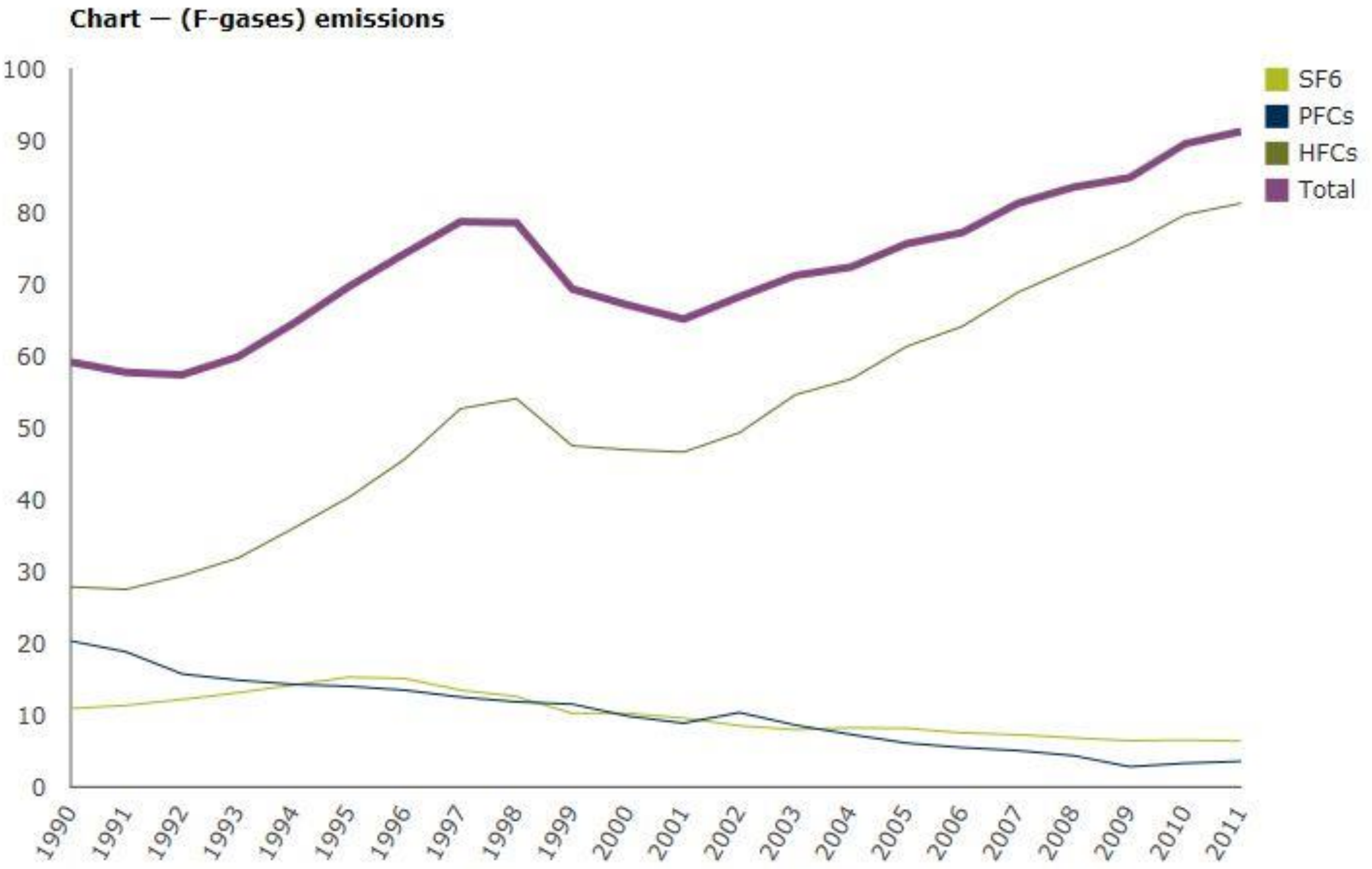

Source: European Environmental Agency, 2014

http://www.eea.europa.eu/data-and-maps/indicators/emissions-and-consumption-of-fluorinated/assessment

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New Regulation (No 517/2014) of Fluorinated Gases including HFCs

In Force as from 11 June 2014, applies from 1 January 2015

20.5.2014 EN Official Journal of the European Union L 150/195

REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 16 April 2014

on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 192(1) thereof,

Having regard to the proposal from the European Commission,

European Commission

Two strategies to reduce emissions

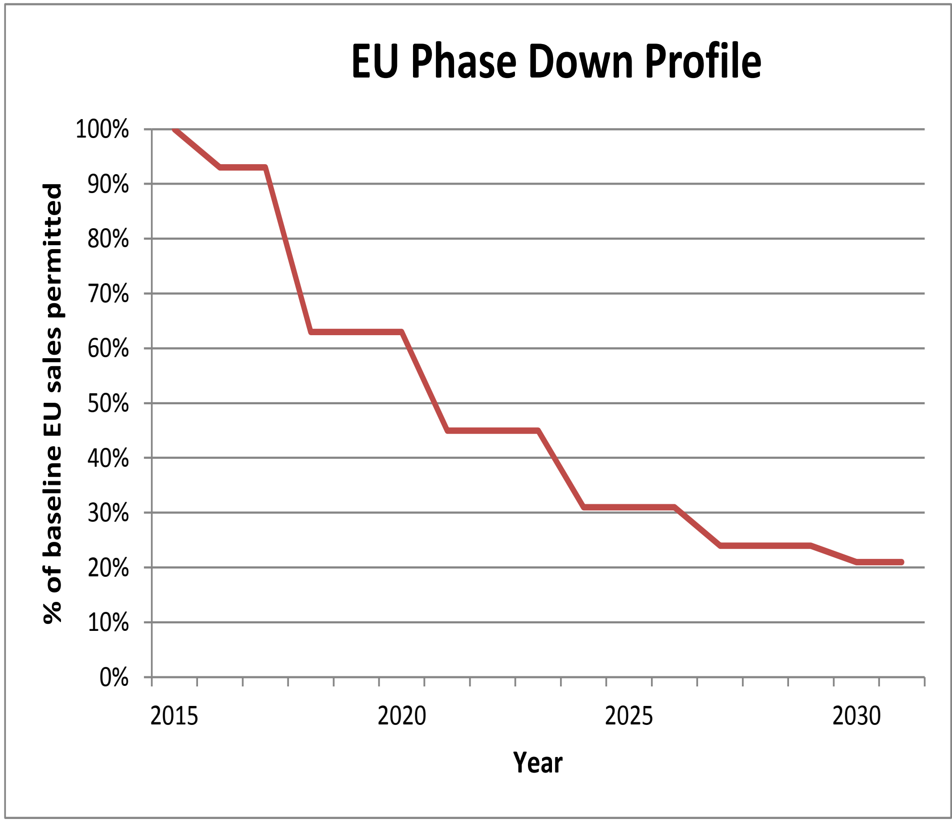
- Prevent leakage and emissions
  - Emission prevention and leak checks -> Art. 2 - 4
  - Control of by-production -> Art. 6
  - End of life treatment of products and equipment -> Art. 7
  - Training and qualification -> Art. 8
  - Information for users (labelling, product infos) -> Art. 10
- Avoid the use of F-gases
  - Training and qualification
  - **Ban on new applications ->** Art. 9
  - **Ban on uses** -> Art. 11
  - **Phase-down of HFC supply** -> Art. 13 ff.

Main measure: EU HFC phase-down, from 2015 onwards

- *Upstream: Reduce current EU sales of HFCs in 3 year steps by (almost) 80% (2030)*

- *Freeze in 2015,*
First step in 2016

- *Tailend for applications where there are no alternatives today*



HFC phase-down – the main novelty

- The phase-down concerns:
  - **All HFC bulk gases placed on the EU market (imports + EU production)**
  - **Imported precharged RAC equipment included from 2017**
- Companies are assigned quotas in CO_2 equivalent, leaving flexibility in actual substances to be put on market

-> you can sell more of your substance if it has a low GWP!

Proposed bans and their context

1. Addressing non-HFCs and by-production

   E.g. Recovery/Destruction of HFC-23 by-production

2. "Steering" the HFC phase-down

   - **Ban to service refrigeration equipment with high GWP HFCs (no 404A/507!) from 2020**
   - **Additional bans for <u>new</u> equipment**

Guiding principles:

- *Existing equipment should not become obsolete*
- *Bans only when alternatives are available (= safe, energy efficient, economically viable)*

MAP OF HC PLUG-IN UNITS & INDIRECT NH_3 AND HC STORES IN EUROPE 2013

DATA BY COUNTRY

TOTAL Hydrocarbon Plug-in UNITS: 480k+

TOTAL Indirect Ammonia SUPERMARKETS: 3

TOTAL Indirect Hydrocarbon SUPERMARKETS: 285

These figures are based on a 2013 survey of leading system suppliers and commercial end-users. Feel free to contact us to add your data to the map. Send an email to research@shecco.com

Source: Shecco

	RAC Market	% 2010 HFC Demand	Approximate GWP Threshold for New Product Ban				Restrictions in EU legislation
			150	700	1400	2500	
Refrigeration	Domestic refrigeration	0.2%	🟢				banned from 2015 (GWP>150)
	Commercial Small Hermetic	0.2%	🟢				banned from 2020 (>2500) and 2022 (>150)
	Commercial Condensing Units	4%	🔴	🟡	🟢	🟢	banned from 2020 (>2500)
	Commercial Multipack	33%	🟢	🟢		🟢	banned from 2020 (>2500) and 2022 (>150) [allowing cascades with GWP<1500]
	Transport Refrigeration	1%	🟡	🟡		🟡	
	Industrial Small / Medium DX	8%	🔴	🟡	🟢	🟢	banned from 2020 (>2500)
	Industrial Large DX	3%	🟢			🟢	banned from 2020 (>2500)
	Industrial chillers	1%	🟢	🟢			banned from 2020 (>2500)
	Industrial flooded	0.1%	🟢			🟢	banned from 2020 (>2500)

Key to Traffic Lights	
🟢	Ban suitable (but may need small number of exemptions in some sectors)
🟡	Ban may be suitable for part of sector, but more commercial development needed
🔴	Ban not suitable at this time

Based on work by SKM Enviros

European Commission

			Group 1: Very Low GWP (<10)					
			1	2	3	4	5	6
Reference	Sector	Sub-Sector	Ammonia	CO_2	HCs	HFO 1234yf	HFO 1234ze	DR2 / N12
1.1	1. Domestic refrigeration	Refrigerators MT	🔴	🔴	🟢	🟢	🔴	🔴
1.2		Freezers LT	🔴	🔴	🟢	🟢	🔴	🔴
2.1	2. Commercial refrigeration	Small hermetic units MT	🔴	🟢	🟢	🟢	🔴	🔴
2.2		Small hermetic units LT	🔴	🟢	🟢	🟢	🔴	🔴
2.3		Single condensing units MT	🔴	🟡	🔴	🟢	🔴	🔴
2.4		Single condensing units LT	🔴	🟡	🔴	🔴	🔴	🔴
2.5		Multipack centralised systems MT	🟡	🟢	🔴	🔴	🔴	🔴
2.6		Multipack centralised systems LT	🟡	🟢	🔴	🔴	🔴	🔴
3.1	3. Transport refrigeration	Vans and light trucks LT + MT	🔴	🟢	🟡	🟡	🔴	🔴
3.2		Large Trucks and Iso-Containers LT + MT	🔴	🟢	🟡	🟡	🔴	🔴
4.1	4. Industrial refrigeration	Small direct expansion (DX) LT	🔴	🟡	🔴	🔴	🔴	🔴
4.2		Small DX MT	🔴	🟡	🔴	🟢	🔴	🔴
4.3		Medium DX LT	🟡	🟡	🔴	🔴	🔴	🔴
4.4		Medium DX MT	🟡	🟡	🔴	🟡	🔴	🔴
4.5		Large DX LT	🟢	🟢	🔴	🔴	🔴	🔴
4.6		Large DX MT	🟢	🟢	🔴	🟡	🔴	🔴
4.7		Medium industrial chillers MT	🟢	🟡	🟡	🟡	🟢	🔴
4.8		Large industrial chillers MT	🟢	🟡	🟡	🟡	🟢	🔴
4.9		Large pumped / flooded LT	🟢	🟢	🟡	🔴	🔴	🔴
4.10		Large pumped / flooded MT	🟢	🟢	🟡	🔴	🔴	🔴

SKM Enviros, 2013

	RAC Market	% 2010 HFC Demand	Approximate GWP Threshold for New Product Ban				Restrictions in EU legislation
			150	700	1400	2500	
Air-Conditioning and Heat Pumps	Small portable units	1%	🟢				banned from 2020 (<150)
	Split systems	20%	🔴	🟡			banned from 2025 (<750)
	Packaged systems	0.4%	🔴	🟡			
	VRF systems	2%	🔴	🟡			
	Small and medium chillers	6%	🟡	🟢			
	Large chillers	2%	🟢				
	Domestic hydronic heat pumps	1%	🔴	🟡			
	Other heat pumps	1%	🔴	🟡			
	MAC: cars and vans	10%	🟢				banned via MAC Directive (2011 for new car types, 2017 for new cars)
	MAC: large vehicles	7%	🟡	🟡			

Key to Traffic Lights	
🟢	Ban suitable (but may need small number of exemptions in some sectors)
🟡	Ban may be suitable for part of sector, but more commercial development needed
🔴	Ban not suitable at this time

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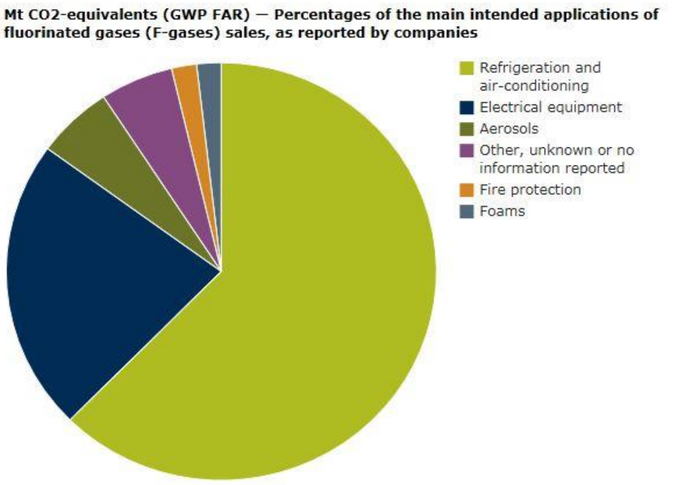
Based on work by SKM Enviros

RAC Market		Approximate GWP Threshold for New Product Ban				Restrictions in EU legislation
		150	700	1400	2500	
Foams	XPS	●				banned from 2020 (>150)
Foams	Others incl. PU	●				banned from 2023 (>150)
Aerosols	For novelty use	●				banned from 2009 (>150)
Aerosols	For technical use	●				banned from 2018 (>150)
Fire protection	HFC-23	●				banned from 2016

Key to Traffic Lights	
● (green)	Ban suitable (but may need small number of exemptions in some sectors)
● (amber)	Ban may be suitable for part of sector, but more commercial development needed
● (red)	Ban not suitable at this time



Based on work by SKM Enviros

Lots of attention by (international) stakeholders has been on the bans

but in reality we think it`s the phase-down (even though not sector-specific and thus flexible) that is driving most changes:

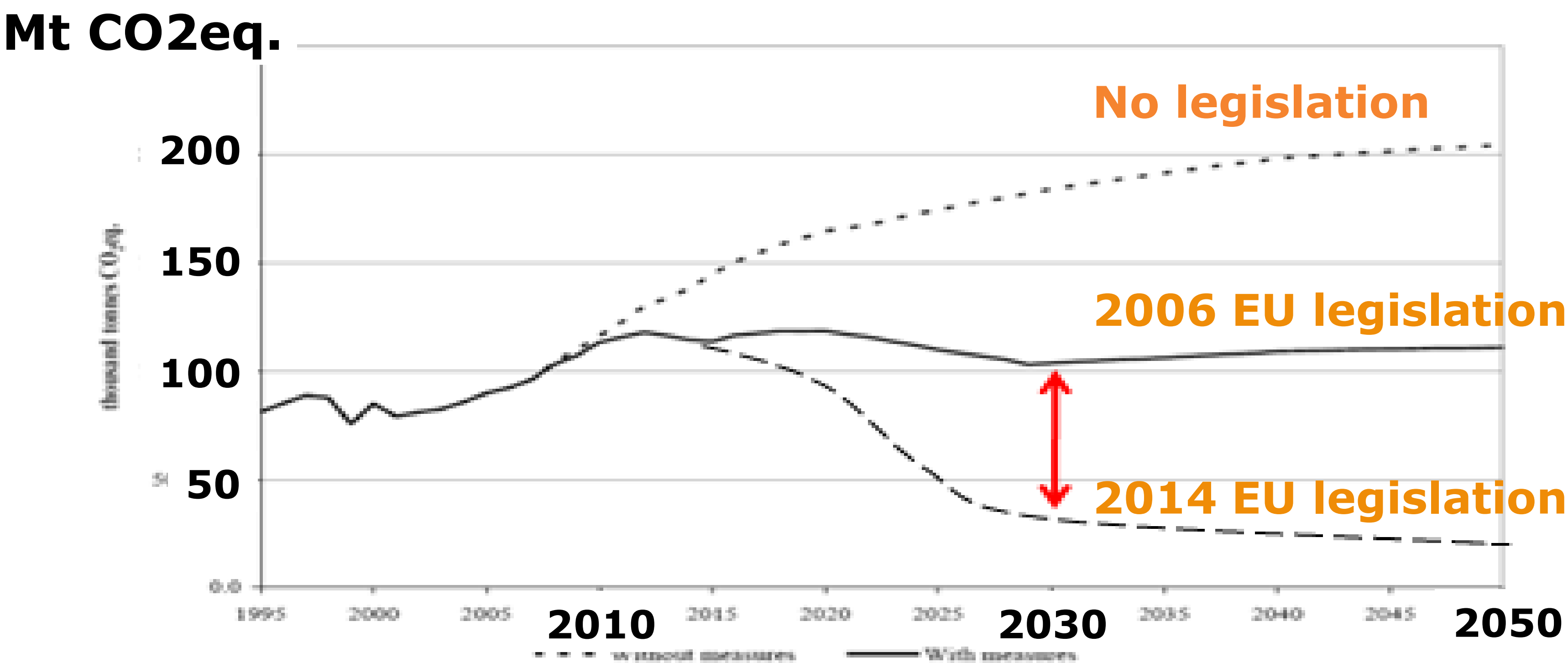
Average GWP today <2000

→ In 2030 GWP <400 (21%)

i.e. a solution of GWP 700 is not good enough unless other sectors do more…

Good savings potential is e.g. given by avoiding refrigerants with GWP > 2500 (404A, 507)

Projected EU F-gas emissions



Cumulative savings of 1.5 Gt by 2030 and 5 Gt by 2050!

INTERNATIONAL

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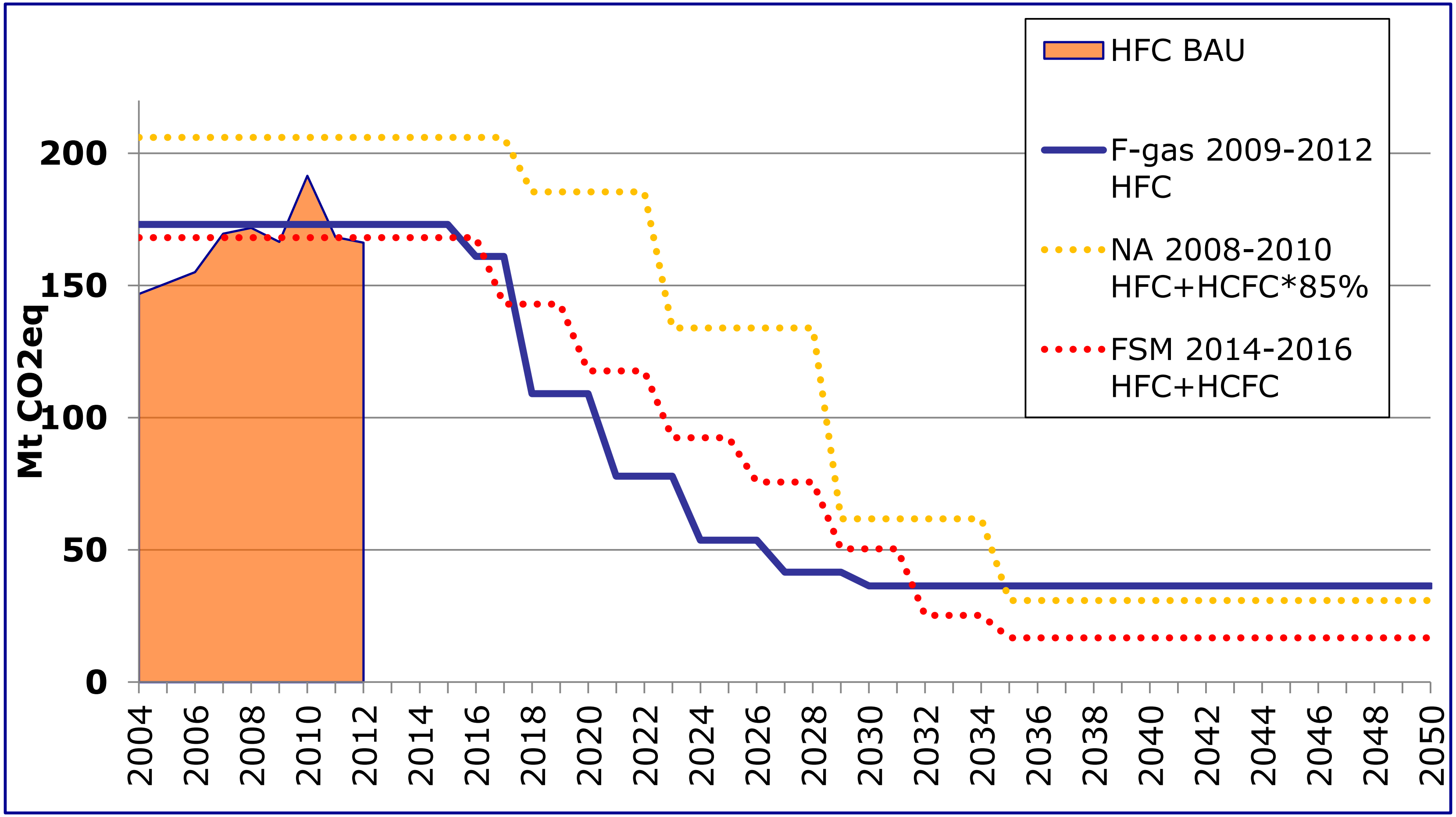

→ For the period 2018-2030 the EU HFC phase-down (= legislation in force) meets all international phase-down proposals (under Montreal Protocol)

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EU actions on F-gases in international context

- *EU phase-down demonstrates measures are feasible*
- *Increased EU demand for alternative technologies*
  - innovation and economies of scale also in other markets
    - hence reducing costs of a global phase-down of HFCs
- *Looking for international collaboration to achieve faster reductions of HFC consumption (bilateral statements with US, China)*

There is a unique window to save money and effort by acting now, by (i) reducing existing use of HFCs, and (ii) using low-GWP alternatives when replacing ozone depleters

The EU approach

- Support for HFC amendment proposals
- Encourage other Article 2 parties to pursue a similar level of ambition as the new EU Regulation
- Consideration of elements that could be changed to reach international consensus:
  - Focus on maximizing **climate benefits of the HCFC phase-out**
  - For Article 5 parties: Freeze of combined HCFC and HFC consumption, expressed in CO_2 equivalents
  - Collection of data on HFCs before deciding on long-term reduction schedule

To know more…

http://ec.europa.eu/clima/policies/f-gas/index_en.htm

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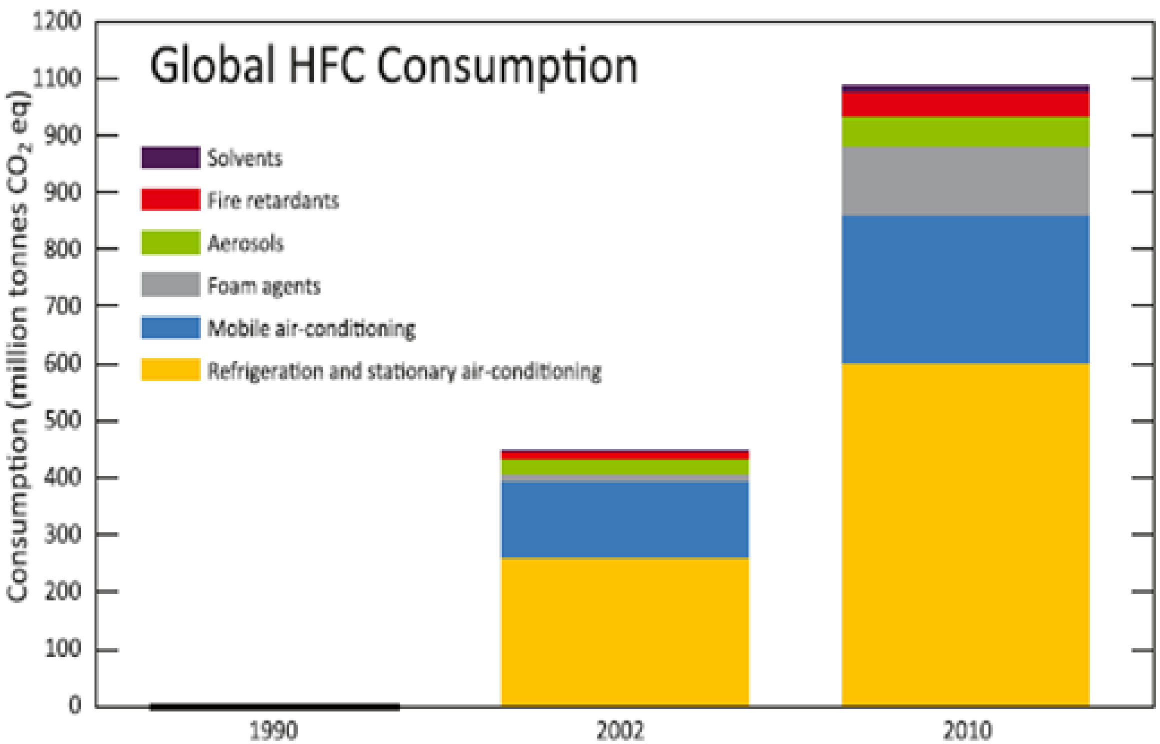
Climate Action

Relevance of fluorinated gases (F-gases)



Source: UNEP, 2011

Gas	GWP (AR 4, 100 year)
CO_2	1
Methane	25
Nitrous Oxide	298
HFC 134a	1 430
HFC 404A	3 922
HFC 410A	2 088
HFC 125	3 500
PFC 14	7 390
SF6	22 800

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Why strengthening EU F-gas policy further?

- *Roadmap EU 2050: reduce GHG emissions by 80-95% (1990-level)*
  → Necessary contribution from F-gas sector is 60% reduction in 2030, based on 2005

- *Several technical studies confirmed that F-gases are low-hanging fruits for mitigation*
  → Several suitable (safe, energy-efficient, cheap) low GWP alternatives are available for most F-gas applications!
  → Abatement costs are modest

Pre-2014 EU F-gas Policy (2006) for 28 EU Member States

(1) F-Gas Regulation *Focus on "Refrigerant Management"*

- leak prevention in existing equipment, e.g. leak checks
- training and certification of relevant personnel
- recovery of gases after use
- record keeping and reporting
- some bans

(2) MAC Directive

- bans of HFCs >150 in passengers cars and light trucks

Also policies on ecodesign, ecolabelling, waste,…

Source: Shecco

Relevant studies

- *Clodic et al., 2013,* ***Alternatives to high GWP HFCs In Refrigeration and Air conditioning applications***

http://www.afce.asso.fr/en-france/copy-of-etude-sur-les-alternatives-aux-hfc-a-fort-gwp

- *Schwarz et al., 2011,* ***Preparatory Study for a review of the Fgas Regulation***

http://ec.europa.eu/clima/policies/f-gas/docs/2011_study_en.pdf

- *SKM Enviros, 2013,* ***Possible bans for new RAC equipment*** (Technical paper for European Commission)
- *SKM Enviros, 2012,* ***Phasedown of HFC consumption in the EU – Assessment of Implications for the RAC Sector***
- *European Commission, 2012,* ***Impact Assessment***

http://ec.europa.eu/clima/policies/f-gas/legislation/docs/swd_2012_364_en.pdf europa.eu

European Commission

THE WHITE HOUSE
WASHINGTON

EU-US summit 26 March 2014: Joint Statement

[..] 7. Sustainable economic growth will only be possible if we tackle climate change [..]The EU and the United States demonstrate leadership and are intensifying their cooperation, including: phasing out fossil fuel subsidies, ***phasing down the production and consumption of hydrofluorocarbons (HFCs) under the Montreal Protocol****. [..] We are* ***committed to ambitious domestic action*** *to limit HFC use and emissions.*

Obligations for operators

of refrigeration, air conditioning, fire protection equipment

Refrigerant charge size [kg] ---→	c ≥ 300	30 ≤ c < 300	3 ≤ c < 30	c < 3
Installation by certified persons	√	√	√	√
Leakage prevention & repair	√	√	√	√
Regular leakage checks	√	√	√	
Leakage detection systems	√			
Record keeping	√	√	√	
Recovery of HFCs before final disposal	√	√	√	√

- *Difference between ≥30kg and <30kg is frequency of checks (6 vs. 12 months)*

Impacts: Existing EU F-gas and MAC legislation since 2006

F-gas Regulation:

F-gas bans

2010: 3 Mt CO_2-eq
2050: 4 Mt CO_2-eq

containment

2020: 29 Mt CO_2-eq

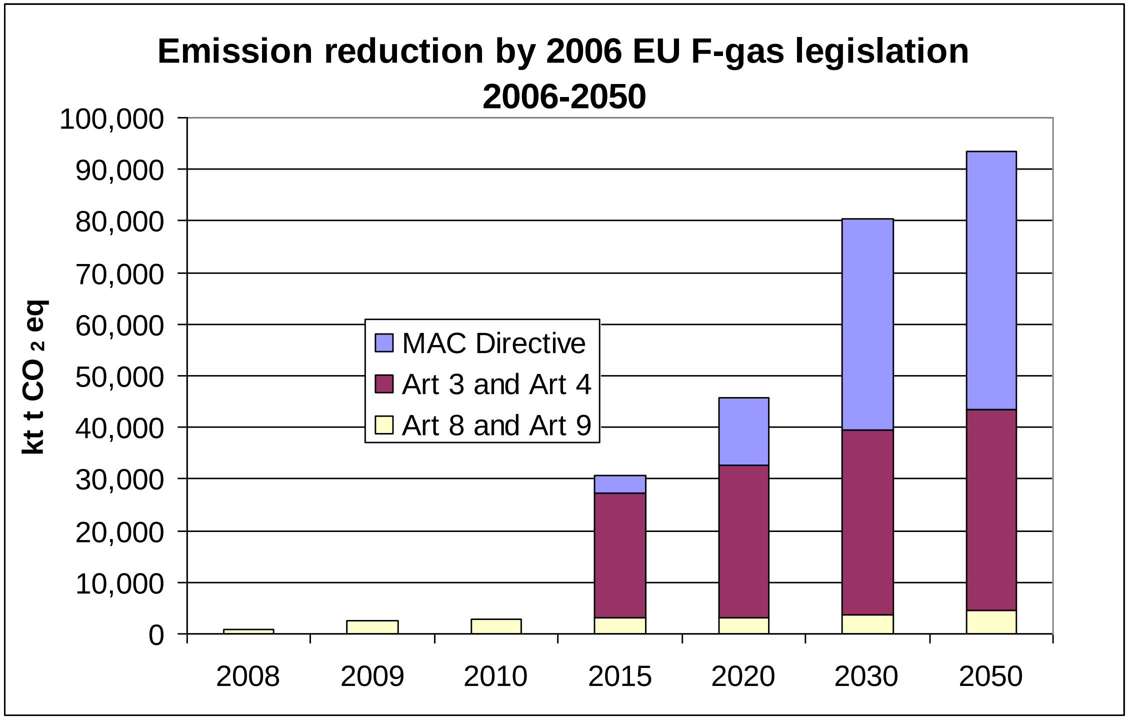
2050: 38 Mt CO_2-eq

Mobile AC Directive:

Ban GWP ≥150

2020: *13 Mt CO_2-eq*

2050: 50 Mt CO_2-eq



Source: Schwarz et al., 2011

Refrigeration options

For larger commercial refrigeration,

R404a is not cool anymore!

→ R404a has GWP of almost 4000

→ There are more energy-efficient options (less costs for endusers!) with lower GWP available, e.g.

- *R407 series as a drop-in solution (supermarkets in UK do it voluntarily!)*
- *CO_2 in cascades (avoid efficiency issue under high T!) <> CO_2 transcritical*

Sheet	3	Condensing Units Commercial Refrigeration					
System		WOM R-404A direct	WM R-404A direct	WAM R-290 direct	WAM R-744	WAM R-290 +secondary liquid	WAM R-1234yf + secondary liquid
refrigerating capacity	*kW*	*15*	*15*	*15*	*15*	*15*	*15*
el power	kW	5	5	4.85	4.85	5	5
running time	h/y	4,380	4,380	4,380	4,380	4,380	4,380
invest cost hardware	€	8,000	*8,000*	9,600	10,260	12,000	12,400
add cost hardware				20%	35%	50%	55%
refrigerant charge	kg	8	8	4	8	1.6	2.4
cost first fill	€	120	120	20	32	8	144
GWP of refrigerant		3,922	3,922	3	1	3	4
lifetime	*years*	15	15	15	15	15	15
cost Ar t3+4	€/y	0	160	0		0	0
add maintenance	€/y				50		
leakage rate	kg/kg	0.10	0.06	0.10	0.10	0.10	0.10
use emissions	kg/y	0.8	0.48	0.4	0.8	0.16	0.24
disp emiss factor	kg/kg	0.5	0.25	0.5	0.5	0.5	0.5
disp emissions	kg/y	0.27	0.13	0.13	0.27	0.05	0.08
consumption	kg/y	1.33	1.01	0.67	1.33	0.27	0.40
global warming emiss	tCO2 eq	4.18	2.41	0.0016	0.0011	0.0006	0.0013
emiss difference to WM	tCO2 eq	1.78	0.00	2.4039	2.4044	2.4049	2.4042
consumption	tCO2 eq	5.23	3.97	0.002	0.00	0.00	0.00
cons difference to WM	tCO2 eq	1.26	0.000	3.97	3.97	3.97	3.97
energy consumption	kWh	21,900	21,900	21,243	21,243	21,900	21,900
cost per kWh	*€*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*
energy cost	€/y	3,066	3,066	2,974	2,974	3,066	3,066
cost refrigerant refill	€/y	12.00	7.20	2.00	3.20	0.8	14.4
discount rate	%	4%	4%	4%	4%	4%	4%
annuity factor discount		0.0899	0.0899	0.0899	0.0899	0.0899	0.0899
annual running cost	€	3,078.00	3,233.20	2,976.02	3,027.22	3,066.80	3,080.40
annual invest cost	€	730	730	865	926	1,080	1,128
annual total cost	€	3,808	3,964	3,841	3,953	4,147	4,209
add ann cost vs WM	€	-155.20	0	-122	-11	183	245
abatem cost emiss	€/tCO2eq			**-51**	**-4**	**76**	**102**
abatem cost consumption	€/tCO2eq			**-31**	**-3**	**46**	**62**
Penetration 2015	%			20	10	5	1
Penetration 2020				30	20	30	20
Penetration 2030				40	30	60	60
Penetration mix 2015				20	10	5	1
Penetration mix 2020				30	20	30	20
Penetration mix 2030				40	30	30	0
first fill 2030	ktCO2eq		5,396				
use em 2030	ktCO2eq		3,885				
disp em 2030	ktCO2eq		1,039				
2030 av abat cost emiss	€/tCO2eq			**1.20**			
2030 av abat cost cons	€/tCO2eq			**0.73**			
red 2030 emissions	ktCO2eq			3,927			
red 2030 consumption	ktCO2eq			8,949			

HFCs in pre-charged equipment

- Of the EU HFC demand, **11%** is imported in pre-filled equipment, rising to **18%** in 2030
- If not addressed, risk of circumvention of the phase-down!

Solution: Obligation to ensure that all HFCs quantities filled in equipment are "accounted for" under the EU phase-down

- *Filling in the EU, or*
- *outside the EU, with HFCs bought in the EU, or*
- *authorisation to use quota from a quota holder (producer/importer of bulk HFCs)*

Verification through declarations of conformity and audited reports