Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases

Final Report

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Executive Summary

Background

Fluorinated greenhouse gases (F-gases) are used in numerous applications and include three types of gases: HFCs, PFCs and SF_6. F-gas emissions are mainly released from refrigeration and air conditioning equipment, foams, aerosols, solvents, fire protection equipment, from halocarbon production, from certain industrial processes in semiconductor and non-ferrous metal industry and from equipment for transmission of electricity during manufacture, use and at disposal.

Due to their relatively high global warming potentials, F-gases are addressed by international conventions such as the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, as well as by policies at European and at national level in EU Member States and other countries, for example Switzerland, Japan, Australia and the USA.

The EU committed to reduce overall greenhouse gas emissions by 8% compared to the base year 1990 during the first commitment period 2008-2012. In order to comply with these commitments, the European Commission identified and developed an EU strategy through the European Climate Change Programme (ECCP) which, inter alia, led to the adoption of Directive 2006/40/EC, the so-called MAC Directive, and Regulation (EC) No 842/2006, the so-called F-gas Regulation.

The F-gas Regulation applies since 4 July 2007 with the exception of Article 9 and annex II, which apply since 4 July 2006. The Regulation has been complemented by 10 Commission Regulations adopted between December 2007 and April 2008, which establish certain technical elements of the provisions[1]. Whilst provisions have been directly applicable in the Member States, a few elements rely upon implementation through national legislation.

The MAC Directive, transposed at national level, applies since 5 January 2008. Its measures are expected to reduce F-gas emissions from mobile air conditioning systems in passenger cars from 2011 onwards.

Objective and scope of this project

The overall objective of this project is to assist the Commission in reviewing Regulation (EC) No 842/2006 by providing technical data, analyses and general support. This service contract carried out by Öko-Recherche and partners since December 2009 includes the following tasks[2]:

- A review of relevant F-gas markets and policies internationally as well as in the EU-27, including investigation of possible interactions, complementarities or overlaps amongst the EU F-gas policy framework (F-gas Regulation and MAC Directive) and other EU or international policies.

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[1] Commission Regulations (EC) No 1493/2007, 1494/2007, 1497/2007, 1516/2007, 303/2008, 304/2008, 305/2008, 306/2008, 307/2008, 308/2008.

[2] European Commission: Specifications to tender ENV.C.4/SER/2009/0033 Service contract to provide technical support for conducting a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.

- An assessment of the effectiveness of current EU F-gas policy, through the development of appropriate models and datasets for emission scenarios in EU-27 and an ex-post assessment of the key elements in the current EU F-gas policy.
- An assessment of the feasibility of emerging options for an international emission reduction arrangement for HFCs and, if appropriate, other F-gases by assessing the feasibility and cost-effectiveness of the replacement of F-gases, developing and comparing scenarios for the control of supply and/or production of HFCs while considering any other elements that could be appropriate to complement a possible international reduction arrangement for HFCs.
- The development of options and recommendations for the review of the F-gas Regulation and an analysis of their impacts.

The project was guided by a Steering Group from the European Commission. In addition, an Expert Group consisting of experts on fluorinated gases from authorities in EU-27, industry and non-governmental organisations has commented and provided further input to the work. This process has enabled the authors of this report to substantially improve the model assumptions and background data.

F-gas markets and policies

The main influencing factors for F-gas **markets** include the CFC and HCFC phase out under the Montreal Protocol, which have led to the development of HFCs as substitutes for ODS. For many applications pure HFC species (e.g. HFC-134a) could not reach the refrigeration performance of HCFC-22, therefore blends containing several HFC types were developed and placed on international markets as replacements for HCFCs. HFC production in developed countries is only slightly growing today, while a strong increase in developing countries is projected due to growing demand for HFCs.

F-gas **policies** were identified on international, European and Member State level as well as at national level in countries outside of EU-27. The underlying approaches include regulatory action, market-based mechanisms and voluntary initiatives.

Furthermore, a number of international, European and national standards apply to all sectors relying on F-gases. Although they are, in principle, voluntary to use and do not impose any regulation, many governments, as well as industry groups and trade associations require products or services to adhere to a standard before they can be placed on the market.

Interactions between the EU F-gas policy and other policies have been analysed. In some cases, F-gas policies and pieces of climate and energy legislation as well as waste legislation complement each other (e.g. WEEE Directive, EPB Directive). The Renewable Energy Directive promotes the installation of heat pumps, which has lead to strong growth of this subsector that is expected to continue. In some cases interlinkages between the F-gas Regulation and other policies need to be respected when deciding on particular review options influencing e.g. GWP thresholds set out by other legislation and definitions.

Application of the current EU F-gas policy framework

Whilst provisions of Regulation (EC) No 842/2006 are directly applicable in all Member States a few elements relied upon implementation by Member States. These include provisions on certification/ attestation systems according to Article 5(2) and on penalties according to Article 13. For both aspects, national legislation had to be established and the

Commission had to be informed about. This “implementation” refers to the legal establishment of provisions at Member State level. The relevant notifications of the Member States to the EU Commission serve as indicators. Furthermore, the “application” of the current F-gas Regulation has been analyzed which refers to the realization and possible enforcement of the provisions of the F-gas Regulation in the Member States.

As of 4th July 2011, **notification** for Member States certification/attestation bodies was still lacking from some Member States in all sectors. The status of notification in the largest sector, the stationary refrigeration, air conditioning and heat pump sector according to Regulation (EC) No 303/2008 is illustrated in figure ES-1. Notification for rules on penalties were lacking from 4 Member States.

Figure ES-1: Status of notification of certification bodies in the stationary refrigeration, air conditioning and heat pump sector according to Regulation (EC) No 303/2008 in July 2011.

Green: 20 Member States in compliance with notification obligations.
Red: 7 Member States not yet in full compliance.

A review of the progress in the application of the F-gas Regulation in the Member States considers separately its key provisions: Training and certification (Article 5), containment provisions (Article 3), requirements for proper recovery of F-gases (Article 4), reporting obligations (Article 6), labelling requirements (Article 7) and bans (Article 8 and 9).

With regard to training and certification (Article 5), it should be noted that further to the establishment or adaptation of the legal framework the actual availability of training centres is a prerequisite for the application of the requirements in the Member States. The establishment of training infrastructure for application of the certification requirements of the F-gas Regulation in the main sectors (stationary refrigeration, air conditioning and heat pumps; mobile air conditioning) has improved in almost all Member States during the analyzed time period from early 2010 to July 2011.

The **certification** status in the different sectors varies considerably between Member States. For EU-27, average shares for final personnel and company certification/attestation were determined on the basis of empirical data (table ES-1). About 600,000 persons are subject to certification and attestation requirements according to Regulations (EC) No 303-307/2008, thereof ca. 60% in the mobile air conditioning sector, 38% in the stationary refrigeration, air conditioning and heat pump sector and about 2% in the other sectors.

Table ES-1: Status of final personnel and company certification per sectors, EU-27 (July 2011)

Sector	Personnel holding final certifications	Companies holding final certifications
Stationary refrigeration, AC, heat pumps	48%	43%
Fire protection	34%	9%
High voltage switchgear	72%	-
F-gas based solvents	54%	-
Recovery of F-gases from AC systems contained in passenger cars	43%	-

While in some sectors and Member States the share of certified personnel and/or companies out of the personnel and/ or companies subject to certification provisions is high, certification of personnel and companies are delayed in other sectors and Member States.

This is partly due to delays in the establishment of national legislation implementing the requirements of the F-gas Regulation. In addition, coordination between institutions, industry associations and other stakeholders as well as discussions on recognition of existing qualifications and the integration of the minimum requirements of the F-gas Regulation in the training programs needed time and effort. Furthermore, training facilities and providers had to be put in place in some Member States, in particular for the small, very specialized sectors.

With regard to **containment** (Article 3) and **recovery** (Article 4) provisions, application also differs widely within EU-27. For the effectiveness of containment and recovery measures set out by the F-gas Regulation only little evidence has been found so far. Reliable data on a broad basis to assess the quantitative effects of these measures is not yet available. Systematic enforcement and control activities by authorities with regard to recovery and containment provisions seem to be lacking widely.

Concerning **reporting** obligations (Article 6), it can be stated that reporting is well-established and benefits from experiences made under the earlier ODS reporting, which involved the majority of companies also covered by F-gas reporting. Considering that all large producers/importers/exporters fulfil their reporting obligation, the reported sales and production quantities of F-gases are well within acceptable statistical error range. Control and enforcement mechanisms with regard to reporting seem to be not fully active at this point in time.

Labelling provisions (Article 7) affect in the sector of stationary air conditioning and refrigeration incl. heat pumps around 50.000 companies (OEM and contractors assembling in site components), about 100 F-gas suppliers including suppliers of cylinders for fire protection sector and about 25 manufacturers of high voltage switchgear equipment. Industry efforts focus on harmonization of labels, in particular in sectors where products and equipment are marketed across Europe, and integration of the additional labelling requirements into other labels. Voluntary industry action in terms of labelling of household appliances should be noted. Compliance with labelling provisions is high among large manufacturers active in several Member States. However, not all importers of products and equipment subject to labelling requirements are compliant, which might partly be due to a lack of awareness and/or information.

Bans (Articles 8 and 9) have been the most effective type of measure so far and resulted in significant and measurable reductions of the use of F-gases and hence F-gas emissions. SF_6 has been substituted in large magnesium die casting facilities (>850 kg/year) and is no longer used for filling of vehicle tyres. Full compliance with Articles 8 and 9 can be stated for the novelty aerosols and PU canned foam sub sectors as HFCs are today only used as components of preparations with GWP <150. However, further investigation of the application and potentially enforcement of the bans in soundproof windows seems necessary. Articles 8 and 9 have been applied to a large extent with minor administrative costs since conversion of production in these sectors largely took place so far, without significant needs for enforcement and control by authorities.

Costs associated with the F-gas Regulation result mostly from its application and enforcement in the Member States. One-off costs, which are related to implementation and application of the F-gas regulation, are estimated in the range of €617 million. Almost 90% thereof result from costs for certification of the personnel and companies. 66% of the certification costs relate to the SRAC sector. Recurring annual costs of provisions set out by the F-gas Regulation are estimated at €702 million for EU-27 in 2010, at €1,061 million in 2015 and at €1,551 million in 2030. Containment measures account for high shares of these costs (leakage checks, records) and occur mostly in the stationary refrigeration, air conditioning and heat pump sector. The share of recovery costs increases significantly over time.

Impact and cost-effectiveness of the current EU F-gas policy framework

The impact of the F-gas Regulation is illustrated by a comparison of two scenarios calculated by the model AnaFgas (Analysis of Fluorinated greenhouse gases in EU-27[3]): A counter-factual scenario “Without Measures” (WOM) and a scenario “With Measures” (WM), which includes the MAC Directive and the F-gas Regulation.

Empirically verified data on emission factors of different emission sources are lacking largely.

In particular, quantitative data on large scale on the effects of the containment provisions of Article 3 on emissions of refrigerants and fire protection extinguishing agents (i.e. sectors affected by Article 3) are not yet available. Similarly, for the application of recovery provisions (Article 4) little quantitative information is available on F-gas quantities recovered and recycled on site as well as on waste streams of recovered F-gases for reclamation and destruction. For certain sub sectors such as supermarket and industrial refrigeration, data sets on the use of F-gases during several years have been made available by few companies. However, these limited data do not yet allow extrapolation of emission factors to large scale.

It was generally found that none of the reporting schemes currently established for fluorinated greenhouse gases allows calculation of emission factors in the different sectors reflecting the impact of particular measures for emission reductions.

By taking into account the current state of application of the relevant provisions and assuming that by 2015 all provisions should be fully implemented and applied, it can be expected that emission factors will be reduced significantly during the 2010-2015 period as a result of the containment measures (Article 3) and recovery measures (Article 4) complemented by the training and certification measures (Article 5). The quantified changes

[3] The model AnaFgas is a bottom-up stock model to derive consumption and emission scenarios for F-gases in relevant sectors and sub-sectors for the EU-27 Member States. Data series for consumption and emissions of HFCs, PFCs, SF_6 and HCFC-22 can be modelled for the period 1995 to 2050.

of emission factors are based upon expert estimates and are considered "best case" assumptions.

On this basis, emission reduction potentials of the key types of measures in the current F-Gas policy framework have been calculated (table ES-2). At this point in time only the bans for use and placing on the market are already contributing to measurable emission reductions. In the medium-term a significantly larger emission reduction potential is expected to emerge from containment and recovery measures (Articles 3 and 4), in the sectors covered by these types of measures. Overall, most of the long-term reduction potential is a result of the provisions of the MAC Directive.

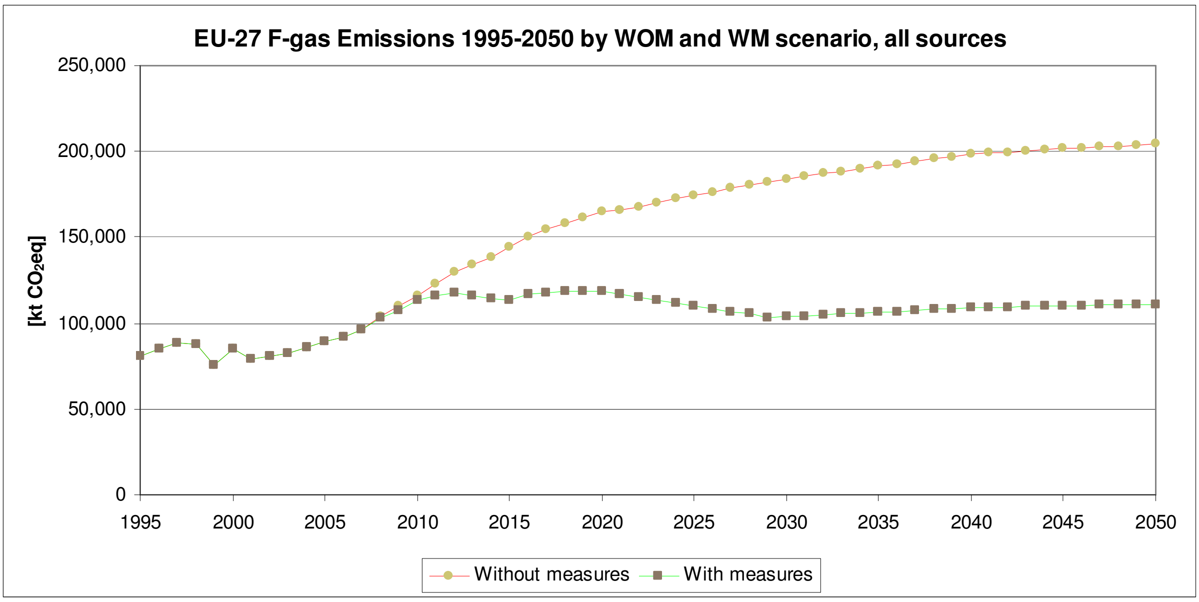

Figure ES-2: F-gas emissions in 1995-2050 in a scenario without measures (WOM) and a scenario with measures (WM) of EU F-gas legislation. The shape of the emission curves indicates the emission reduction potential for F-gas emissions. From 2008 onwards the two curves distinctly split up. In the WM scenario, emissions will remain at a stable level from 2010 until 2050, while in the WOM scenario emissions would continue to increase up to almost the double. It should be noted that even in the WM scenario absolute emissions in 2050 will be higher than in the WOM scenario in 2008 (by 6,800 kt CO_2 eq).

The current EU F-gas policy framework including the F-gas Regulation and the MAC Directive opens up the opportunity to significantly slow down the increase of future emissions (figure ES-2). The emission reduction relative to the WOM scenario totals 2,900 kt CO_2 eq at present (-2.6%), increasing to 30,800 kt CO_2 eq in 2015 (-22%) and 93,300 kt CO_2 eq in 2050 (-46%).

Table ES-2: Emission reduction potentials (kt CO_2 eq) of measures set out by EU legislation on F-gases (including F-gas Regulation and the MAC Directive) in 2008-2050 (WOM-WM)

		2008	2009	2010	2015	2020	2030	2050
MAC Directive		0	0	0	3,419	13,150	40,965	49,916
F-gas Regulation	Art 3 and Art 4	0	0	0	24,357	29,478	35,609	38,815
	Art 8 and Art 9	909	2,687	2,861	3,012	3,223	3,750	4,616
Total		**909**	**2,687**	**2,861**	**30,787**	**45,850**	**80,325**	**93,347**

With regard to cost-effectiveness of the F-gas Regulation, abatement costs of 40.8 €/t CO_2 eq in 2015 and 41.0 €/t CO_2 eq in 2030 have been calculated on the basis of the WM scenario.

Furthermore, significant shares of projected F-gas emissions remain unabated although their sources might be subject to containment and recovery provisions already. The following sectors will contribute large proportions of future F-gas emissions: Room air conditioning, commercial refrigeration, industrial refrigeration.

Currently certain F-gas emissions are not effectively addressed by the EU F-gas policy framework. These include HFC emissions from mobile air conditioning systems contained in ships and rail vehicles, from transport refrigeration and refrigerated ships, from foams, from halocarbon production, HFC-23 by-product emissions, PFC emissions from industry, SF_6 emissions from certain applications. F-gas emissions from Organic Rankine Cycles and emissions from other fluorinated gases are currently not covered (NF_3, SO_2F_2, unsaturated HFCs, other HFCs and PFCs).

In the light of international and EU unilateral commitments to reduce greenhouse gas emissions, further reductions of F-gas emission seem to be appropriate. These will need to be based on additional policy measures.

State and potential of technology in the different sectors

The projected F-gas demand in 2050 and emissions of the WOM and WM scenario are based on sub sector specific assumptions of growth rates. These assumptions do not include in most cases technological changes or growing shares of alternative technologies but are based on continued use of conventional technology ("frozen technology").

In order to identify the maximum reduction potential of F-gas emissions, the potential for the replacement of F-gases by low-GWP solutions in all sectors currently relying on F-gases is assessed. For each sector, technically feasible and cost-effective alternative technologies to sector-typical conventional F-gas technology were identified and are hereafter referred to as "alternative options". The selection of replacement technology was guided by three criteria including the reduction potential of CO_2-weighted use of F-gas and emissions, cost effectiveness (expressed in abatement cost of €/t CO_2 eq) and energy consumption. For each alternative option, the penetration rate, which is defined as maximum potential of each technical choice to replace new products or equipment relying upon F-gas, was estimated. Penetration rates are given for each alternative option based on technical feasibility to replace existing F-gas technology by a specific alternative technology, at least cost.

On the basis of a sector penetration mix, which is the set of alternative options in a sector with the highest aggregated technical reduction potential, sector specific (average) abatement costs and related reduction potentials for demand and emissions of F-gases through the use of alternative technologies in 2030 are calculated.

At the international level, this results in the findings that HFC consumption in 2030 can be reduced by ca. 760 Mt CO_2 eq in developed countries (figure ES-3) and by almost 2,000 Mt CO_2 eq in developing countries (figure ES-4) at costs < 20 €/t CO_2 eq. In both, developed and developing countries, abatement costs > 20 €/t CO_2 eq occur for abatement options in buses, multi split systems, ducted air conditioners, and heat pumps.

At EU level, technically feasible and cost effective abatement options are analysed in terms of HFC demand reductions (=potential emissions) and actual HFC emission reductions. In relation to the WM scenario, HFC demand of 136 Mt CO_2 eq can be reduced at costs < 20 €/t CO_2 eq in EU-27 in 2030 (figure ES-5) and HFC emissions of 66 Mt CO_2 eq can be abated at costs < 25 €/t CO_2 eq in EU-27 in 2030 (figure ES-6).

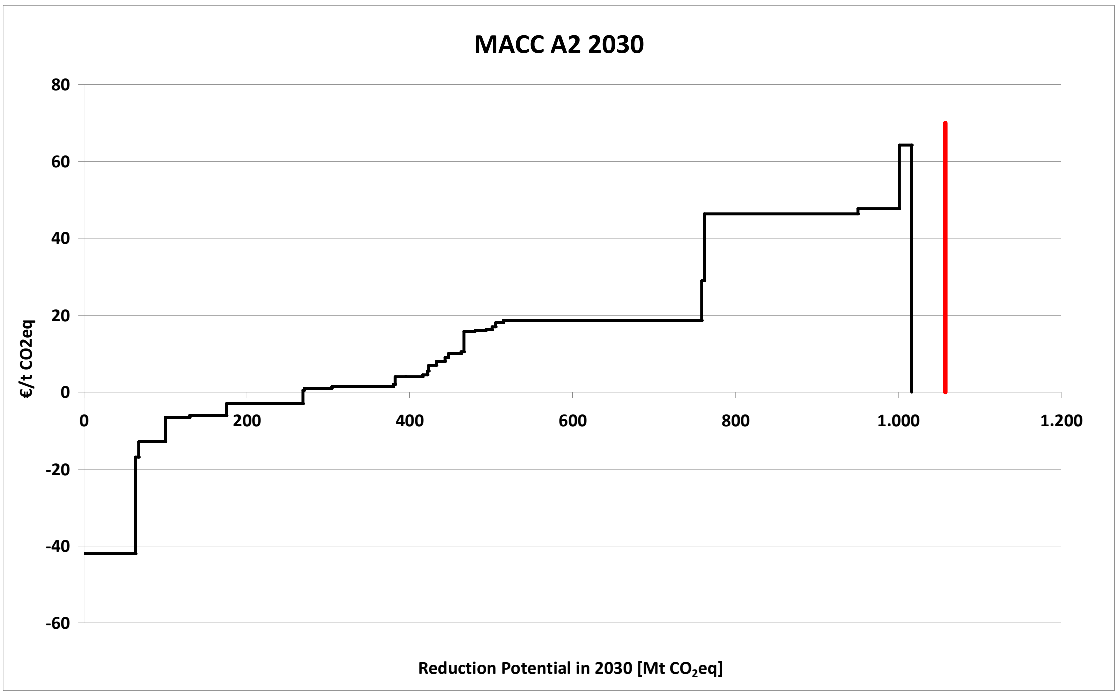

Figure ES-3: Marginal Abatement Cost Curve for consumption reductions in developed countries in 2030. The red line on the right indicates total HFC consumption in developed countries in 2030.

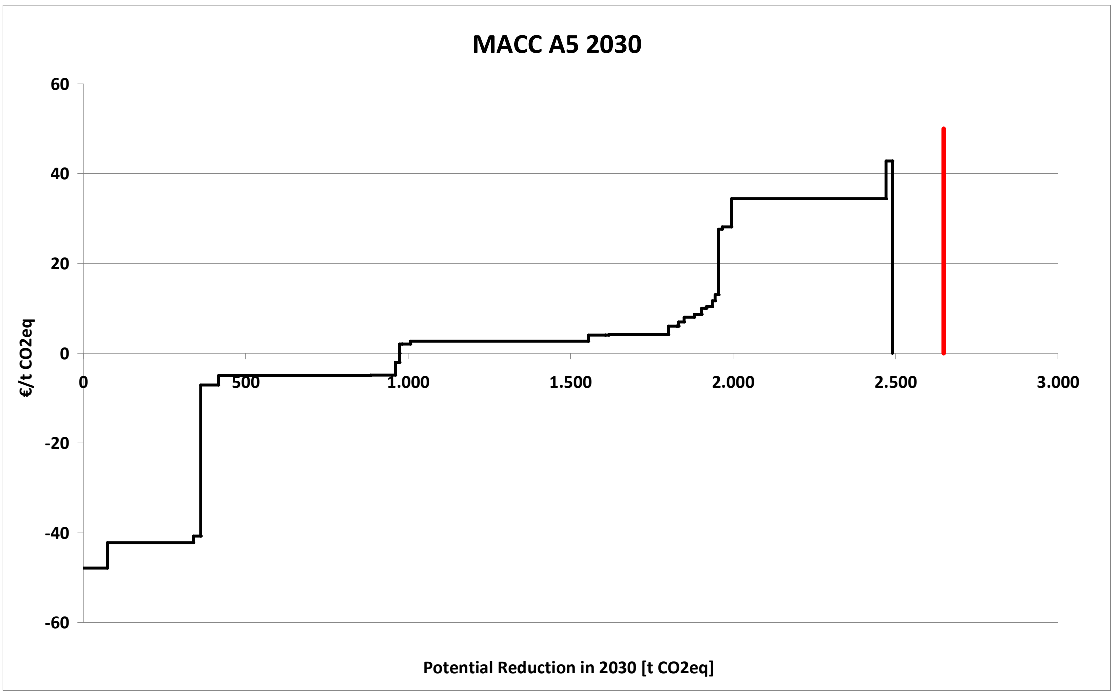

Figure ES-4: Marginal Abatement Cost Curve for consumption reductions in developing countries in 2030. The red line on the right indicates total HFC consumption in developing countries in 2030.

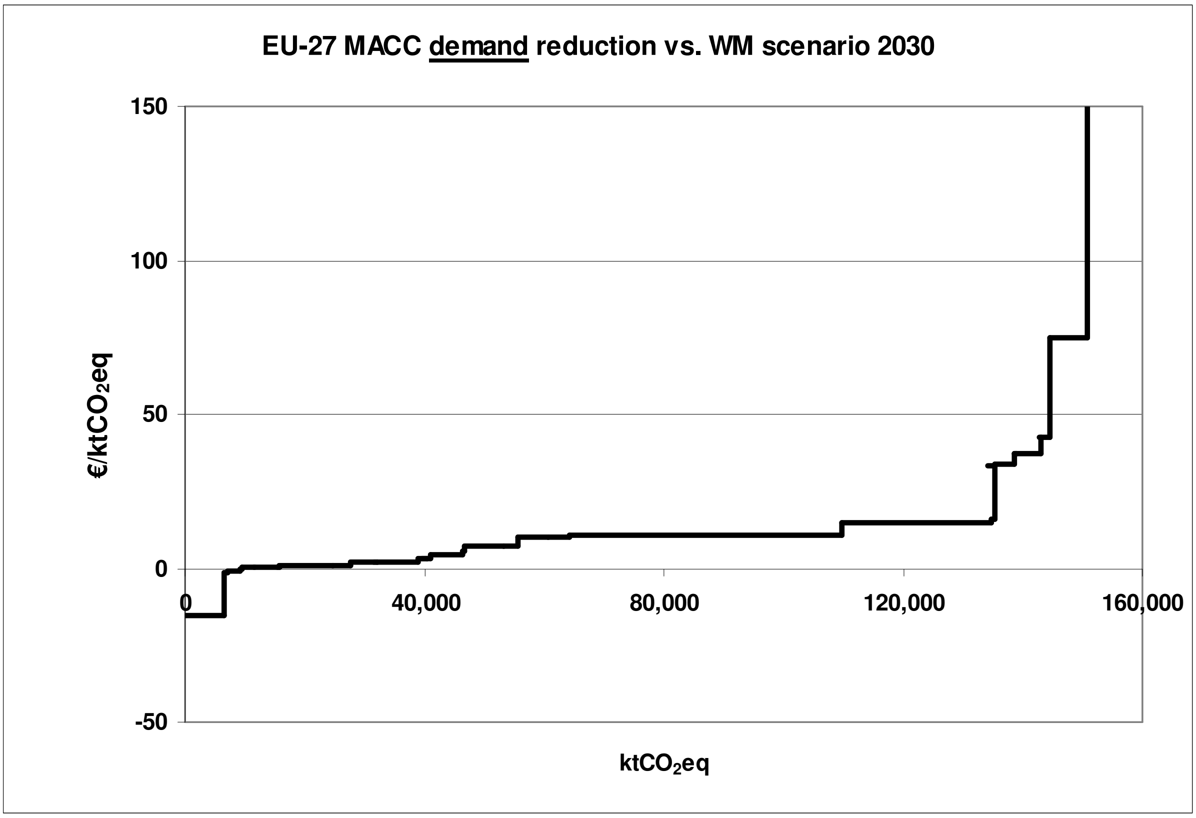

Figure ES-5: Marginal Abatement Cost Curve for F-gas demand reduction in EU-27 in 2030. Demand includes quantities contained in pre-filled imported equipment imported in the EU.

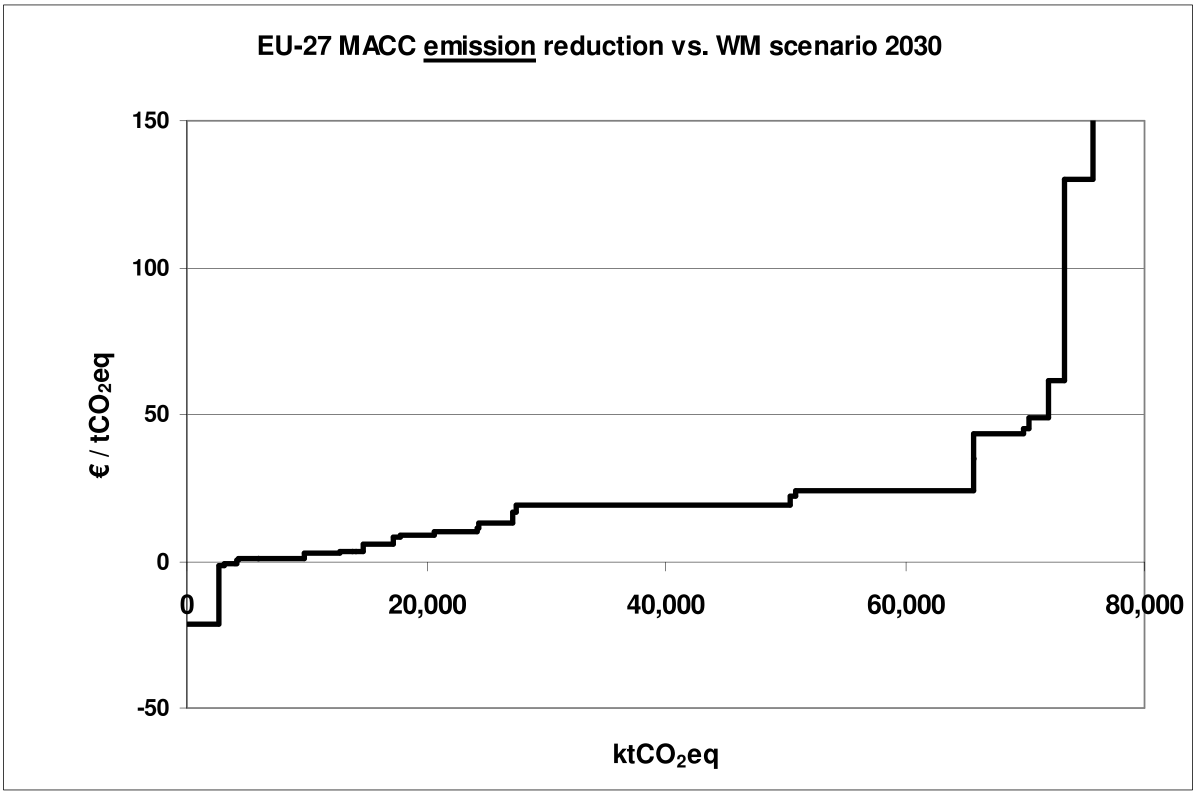

Figure ES-6: Marginal Abatement Cost Curve for F-gas emission reductions in EU-27 in 2030.

Options for further international action to reduce F-gas emissions

Scenarios project HFC consumption during the period 2010-2030 under business-as-usual (BAU) and technically feasible reductions of global HFC consumption in the same period in both developed and developing countries.

Growing use of HFCs and hence emissions are mainly a result of the phase out of ODS under the Montreal Protocol: HFC demand in developing countries is projected to increase drastically in the next decades, while HCFC demand will decrease (BAU scenario). HFC demand in developed countries is only slightly growing and likely to reach stable levels around 2030.

As F-gas markets are global markets, HFC production is often taking place in one country while HFC consumption and related emissions during and at the end of product life take place in other countries. Local or regional policy action can hence only address the contribution of HFCs to global warming to minor extent, while international action is thought to be able to achieve significant consumption and emission reductions at large scale.

Current policy discussions at international level treat the question on how to link the work on F-gases, in particular HFCs, done under the UNFCCC climate regime and further phase out of ODS under the Montreal Protocol more closely. The Montreal Protocol holds a special role as it addresses most industries and sectors which rely on F-gases while not addressing these gases. It could be possible to abate HFC emissions in a similar way as ozone-depleting substances by applying an approach similar to that of the Montreal Protocol.

Two existing proposals for HFC phase down under the Montreal Protocol resubmitted by Northern American (NA) countries and the Federated States of Micronesia (FSM) in 2011 are turned into the "NA scenario" and the "FSM scenario".

Based on the findings on abatement technologies for each sector, potential HFC supply reduction scenarios for developed and developing countries are calculated: A reduction scenario (RED) is based on all technically feasible abatement options identified for each sector at the maximum penetration rates in a particular year. Another reduction scenario (RED10) is based on technically feasible abatement options at abatement costs <10 €/t CO_2 eq identified for each sector at the maximum penetration rates in a particular year.

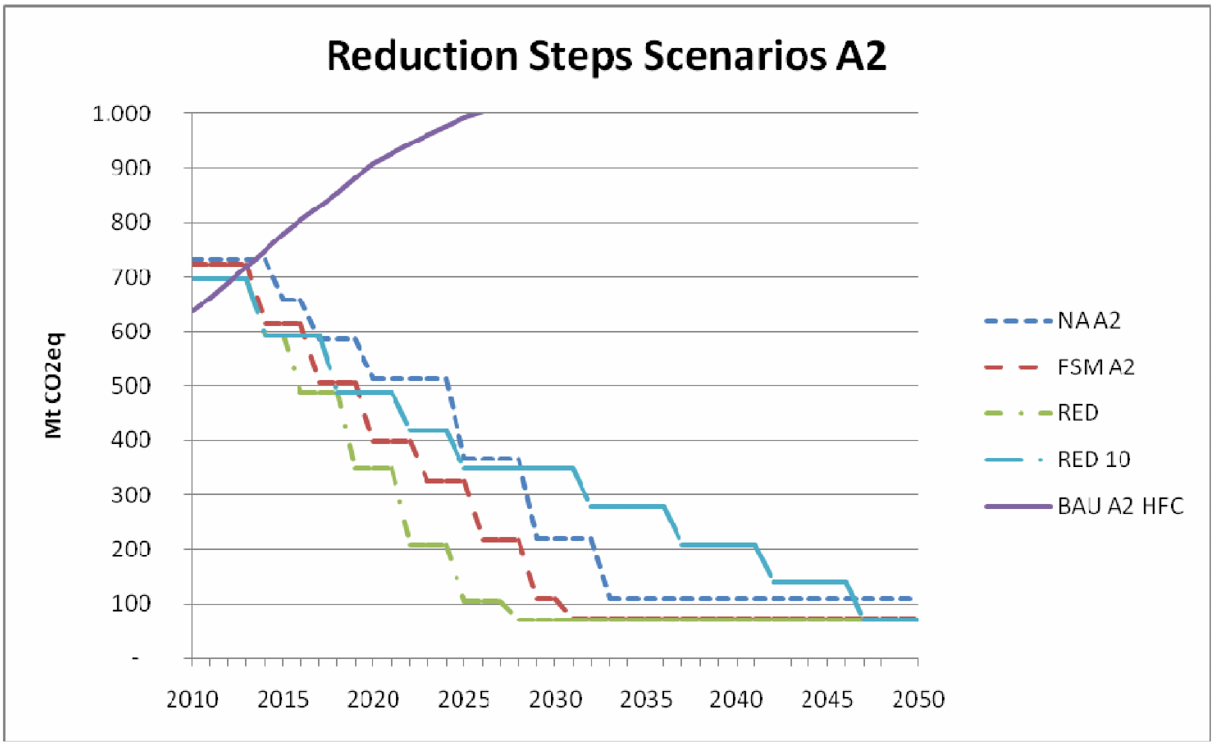

Figure ES-7: Comparison of scenarios for HFC phase down in developed countries.

The reduction scenarios, the NA scenario and the FSM scenario are compared (figure ES-7 for developed countries) with regard to the control schedules for developed and developing countries as well as their global HFC consumption reductions.

Options for further EU action to reduce F-gas emissions

The identification of policy options for further EU action is based on the project work and includes the forward looking options listed in Article 10 of the Regulation. The WM scenario calculated by the model AnaFgas serves as reference and allows comparison of different policy options.

Policy options for further action describe different ways forward and are, in most cases, mutually exclusive, although certain of the options and many of the sub-options might complement each other. The main options/ sub-options include:

Option A Business-as-usual (do nothing).

Option B Suspend provisions of the F-Gas Regulation. This option was discarded from further analysis because such approach would clearly not be in line with the EU's overall climate objectives.

Option C Non-regulatory approaches.

C-1: Environmental agreements and self-regulation.

C-2: Improved coordination.

C-3: Enhanced technical standards

Option D Further regulatory action (includes several sub-options addressing particular sectors, types of measures and/or types of F-gas emissions).

D-1: Include F-gases currently not covered in annex I of the F-gas Regulation.

D-2: Enhance application and monitoring of the Regulation.

D-3: Improve containment and recovery in certain sectors.

D-4: Ban the use or the placing on the market of open F-gas applications.

D-5: Ban the placing on the market of certain closed applications containing F-gases, where energy efficient and safe alternatives are available. This option considers potential bans for different closed applications of F-gases starting in the period 2015-2030.

D-6: Set quantitative limits for the placing on the market of F-gases in the EU-27. This option is based on stepwise limits to HFC supply, thereby drives the introduction of alternative technologies and hence reduces F-gas emissions.

D-7: Development and dissemination of BAT and BREF notes and documents.

D-8: Obligation to destroy HFC-23 by-product emissions from halocarbon production.

Option E includes market-based approaches.

E-1: Include additional activities under the EU-ETS.

E-2: Tax schemes.

E-3: Deposit and refund schemes.

In a screening, the policy options were assessed against several criteria such as effectiveness (threshold of 1 million t CO_2 eq), efficiency (threshold of 50 €/t CO_2 eq), technical constraints and other qualitative criteria. The screening resulted in a short list of key policy options, which are subject to the subsequent impact analysis (table ES-3).

Table ES-3: Overview of key policy options and their additional emission reduction potential in 2030 (kt CO_2 eq)

Proposed policy option	**Additional emission reduction potential in 2030 (kt CO_2 eq)**
Voluntary agreements	21,702
Improve containment and recovery under F-gas Regulation: Refrigerated trucks and trailers	1,430
Ban the placing on the market of certain open applications containing HFCs	5,190
Ban the use of SF_6 in open applications	250
Ban the placing on the market of certain closed applications containing F-gases	47,089
Limits for the placing on the market of HFCs in EU	71,740
Obligation for HFC-23 by-product destruction	370

All of these options could be supplemented by approaches under option D-2 aiming at improvement of the existing legislation and its application through additional information and guidance. Emission reduction potentials and abatement costs for such modifications are not quantifiable.

In order to achieve maximum abatement of F-gas emissions, a combination of the option "Limits for the placing on the market of HFCs in EU", the options "Ban the use of SF_6 in open applications" and "Obligation for HFC-23 destruction" was chosen as it provides the maximum emission reduction potential of ca. 72,500 kt CO_2 eq in 2030.

This combination is the basis of the third scenario "With additional measures" in the model AnaFgas. It is shown in figure ES-8, in comparison with the WOM and WM scenario.

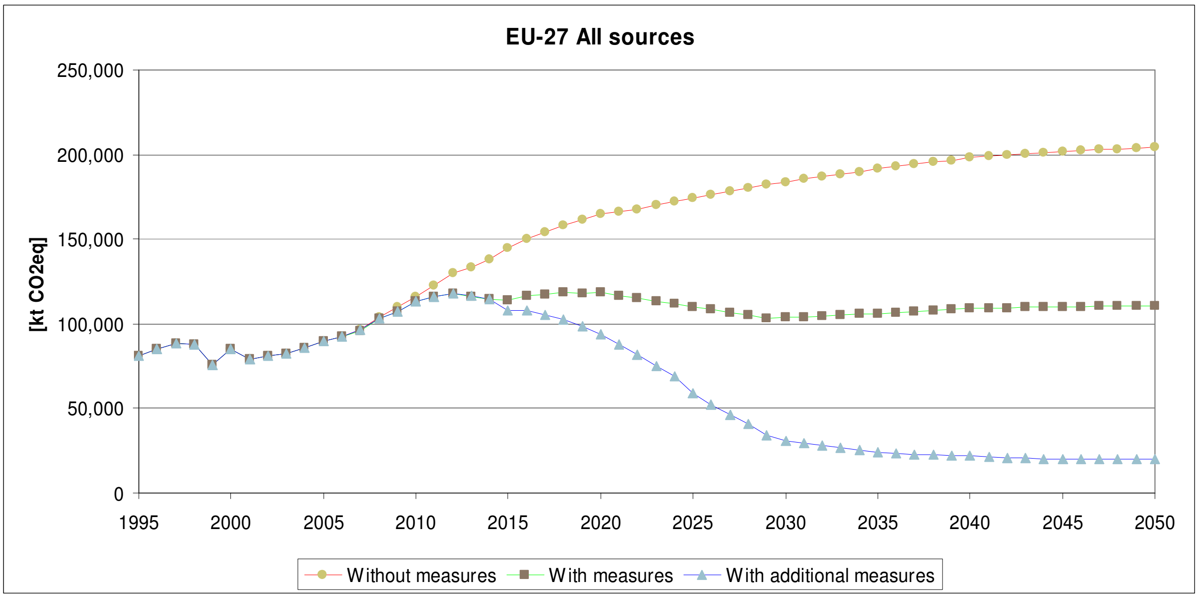

Figure ES-8: The three emission scenarios for EU-27 in the model AnaFgas.

Likely effects of the key policy options were considered in terms of their environmental, economic and social impacts on the basis of quantitative or qualitative analyses.

With regard to emission reductions, the option "quantitative limits for the placing on the market of fluorinated gases" shows the highest potential (direct: 71.7 Mt CO_2 eq; indirect: 1.6 Mt CO_2 eq), followed by the option "ban of the POM of certain closed applications containing F-gases" (direct: 47.1 Mt CO_2 eq; indirect: 0.7 Mt CO_2 eq) and the option "voluntary agreements" (direct: 21.7 Mt CO_2 eq; indirect: 0.5 Mt CO_2 eq). The abatement costs for these three policy options with high emission reduction effects are comparable and range at 14 - 17 €/ t CO_2 eq.

The direct net costs for affected sectors are the highest in the option "quantitative limits for the placing on the market of fluorinated gases" (1,083 M€/year), followed by the option "ban of the POM of certain closed applications containing F-gases" (675 M€/year). The investment costs are also the highest for the option "quantitative limits for the placing on the market of fluorinated gases" (5,613 M€/ year in 2030) and comparably high for the option "ban of the POM of certain closed applications containing F-gases" (2,860.2 M€/ year). Due to the fact that these options result in the largest new investments in the affected subsectors, they are expected to also have the highest positive effects on employment via the creation of new jobs.