A REPORT BY ENVIROS CONSULTING LIMITED

ASSESSMENT OF THE COSTS & IMPLICATION ON EMISSIONS OF POTENTIAL REGULATORY FRAMEWORKS FOR REDUCING EMISSIONS OF HFCs, PFCs & SF_6

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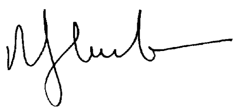

EXECUTIVE SUMMARY

This report summarises research performed in January to May 2002 to assess the current regulatory frameworks in place in each member state and the costs and potential benefits of applying new regulations to the use of “F gases” across the EU. Views have been sought from Government, Industry (gas and equipment manufacturers, contractors and end-users) and NGOs. Over 100 interviews have been conducted, together with consultation with both the industry and Government representatives of the ECCP and the information collected has been analysed in conjunction with the findings from the ECCP work on F gases completed last year. There were three main objectives to our study:

- Review STEK (STEK is used as shorthand for the Dutch system of F gas regulation) and compare to member state policy
- Assess Cost Implications and emissions reductions potential
- Identify effects on the public and private economy.

All our emission reduction estimates are based on the Business As Usual Scenario projected in the ECCP report since these have been generally accepted by both the Commission and industry. Our main findings are as follows:

STEK

- Stek is well known to the refrigeration industry and other major stakeholders
- Stek has been highly successful in the Netherlands in both minimising average leakage rates and in virtually eliminating “rogue traders”, reducing equipment leakage rate to 4.5% p.a. compared to a European average of 15%
- In its current form, Stek is seen as technically and bureaucratically onerous on industry. It is prescriptive to a very high level of detail and it also requires a high level of record keeping. These increased demands place added cost on industry and have resulted in the closure of some smaller firms and have added cost in the remaining businesses.
- STEK provides additional benefits to industry through improved energy efficiency and improved process and quality control.

Cost Implications & Emission Reduction Potential

- To establish the cost of the regulatory framework, desk research and interviews were conducted to estimate the likely costs and potential leakage reductions achievable, and the costs of establishing current systems were requested from Government Departments.
- Costs to establish future systems were then extrapolated based on population, gdp, refrigeration usage, numbers of refrigeration companies and contractors, labour costs and the status of current legislation.

- To establish trends in refrigeration leakage rates, over 40 refrigeration contractors were interviewed. Information gained was combined with that used in the earlier ECCP report

- The cost effectiveness of implementing a STEK-like system on a Community basis have been estimated as follows:

Regulation	Total Annual Saving in 2012 Mtonnes CO_2 equiv.	Average Cost effectiveness per Tonne (Euros)
STEK	15.0	18.32

Impact on Industry

- A full blown STEK system would result in the closure of some smaller refrigeration contractors adversely affecting companies with many small contractors such as the UK and Italy

- Other regulations including WEEE, IPPC and the ELV directive will provide extra coverage of emission reduction policy in some sectors (domestic refrigeration, gas manufacture and MAC)

1. INTRODUCTION

This report documents the results of a research based assessment of the costs and impact on emissions of a potential regulatory framework for reducing emissions of HFCs, PFCs and SF_6 (the F-gases). Over 100 interviews have been conducted with Government and Industry. There were three main objectives to our study:

a) Review STEK[1] and compare to member state policy

b) Assess Cost Implications and emissions reductions potential

c) Identify effects on the public and private economy.

When reading this report it is important to keep in mind that there are certain limitations associated with the study. We commenced our study on the assumption that a potential regulatory framework may be based on the STEK system in place in the Netherlands and that other member states would have or would be working on schemes which could be similarly costed. In fact, during the study it became clear that aside from STEK there was little complete data available from other member states and as a result of this lack of empirical data, we were required to make a number of assumptions on both the costs and benefits available.

1.1 Background to STEK

The STEK approach is a form of public-private co-operation between the Dutch Government and industry. In early 1990, the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM) launched a national action program to end the use and production of CFCs and HCFCs. This approach was based on cooperation with users of refrigerants and manufacturers of equipment containing refrigerants. The aim was to achieve four key objectives:

a) Improve expertise;

b) Develop technical standards for equipment;

c) Set up an independent authority to approve companies allowed to work with chemical refrigerants;

d) Provide Government legislation to ensure implementation.

In addition to certification of individuals, STEK also includes:

- Registration of contractors
- Registration of equipment over 500 watts compressor power input
- Technical requirements for equipment design and manufacture
- Auditing of companies
- Monitoring of refrigerant use
- Training

1 Throughout this report the term "STEK" is used to denote the system used in the Netherlands since 1992 to control use of refrigerant gases and currently used to implement Articles 16 and 17 of Regulation (EC) 2037/2000.

1.1.1 Set Up Costs

The information used in this estimate is based on our interview conducted with Dick Theunissen of STEK.

To establish STEK in 1992 the Government provided a subsidy of €150,000 to cover start up costs plus an additional €60,000 to establish 6 test centres. This subsidy covered approximately half of the initial set up charges and industry covered the remainder. Subsequent discussions with VROM suggest that this figure underestimates the true cost and a total figure of € 750,000 has been agreed with VROM as accurate. – **Total cost €750,000**

The individual examination is taken at one of a number of independent centres, currently costing €363 . It can be based on a 5-day study course using a standard book. The examination itself includes a short theory exam and two practical exams (only one for MAC) in handling and installation, which are done on a standard model system with real components. Demonstrably equivalent qualifications from other countries are accepted. **- Total cost €18,000,000 (Based on 7,500 contractors paying €363 each and spending 5 days at €400 per day on a training course[2]).**

1.1.2 Total Set Up Cost:

Govt set up cost	€750,000
Training Cost	€18,000,000
Total Cost	**€18,750,000**

1.1.3 Running Costs

In addition to the costs to establish STEK, there are additional on-going costs to industry covering: annual accreditation, in-house training, additional equipment requirements and the labour costs of extra maintenance requirements.

Individuals are certified free of charge on completion of an examination, which differs for general refrigeration and air conditioning and for mobile air conditioning. Employers pay an *annual* fee of €400 to €4400 depending on the number of employees and the audit company chosen. There are no exceptions to the requirements, either for companies or for established employees. - Total cost €1,500,000 (2,000 companies paying an average of €730[3]).

This registration fee is to cover the costs of the accreditation body for auditing and policing. STEK has been running for 10 years in the Netherlands and there is free competition in providing accreditation services. It is assumed that this is therefore a stable price.

[2] There is some debate as to whether this element of cost is too high since the business receiving the training is gaining extra value from the training itself. We have taken the view that this is the “highest” marginal cost and could be lower.

[3] Data from the VROM workshop October 2002

It is difficult to estimate the costs of in-house training, additional equipment requirements and the labour costs of extra maintenance requirements accurately. No empirical data has been collected or is available on this element of the cost to industry in the Netherlands. In this study we have assumed that additional labour involved in performing extra servicing will result in productivity savings and take the broad view that these will more or less cancel out in terms of cost and benefit. We have therefore estimated the additional ongoing time cost to industry (in terms of the requirement for additional form filling etc.) as one-man day per contractor. Additional equipment costs will be minimal since most companies would expect to have the nec essary equipment already to comply with regulation 2037/2000. There are also on-going training requirements as new recruits enter the industry (around 5% per annum). Thus the total running costs are estimated as follows:

1.1.4 Annual Costs

Additional Labour cost	€3,000,000
Annual Registration	€1,500,000
Training Cost	<u>€900,000</u>
Total Cost	**€5,400,000**

1.1.5 Timescales

In the first year of operation, to aid a rapid roll out only one operative per company needed to be registered. Thus the scheme was largely up and running within around 12 months. After year one, the number of registered contractors per company was "ramped up" and now all contractors in each company must be registered. General feedback has been that this timescale was too rapid and perhaps two to three years would be more appropriate.

1.1.6 Auditing & Policing

Examination and auditing are "subcontracted" to approved bodies. To ensure competition in price there is a "free market" in this area. Administration is largely electronic, including transmission of audit reports, using standard forms on laptop computers on site. The STEK scheme registers include 2,400 companies, 1.4 million installations, and around 7,500 individuals.

The industry has itself decided to check compliance rather than leaving it to the government. STEK checks company operations for compliance with the CFC regulations and carries out inspections to assess the environmental skills of CFC engineers. So, in fact, the monitoring body is a privatized organization. The government provided initial guidance and financial support. STEK is now self funding, i.e. all revenues collected from registration are spent on auditing activities.

Owners or users of equipment filled with CFCs, HCFCs and HFCs are obliged by law to have their equipment serviced and repaired by a company approved by STEK. Therefore only companies with a STEK approval certificate may carry out work on refrigeration equipment. Quality checks are carried out on registered contractors and to date 5 licenses have been withdrawn. Where instances are identified of rogue installations using non-registered contractors substantial fines can be applied. There have been 5 court cases with fines ranging from €30,000 to €60,000. Because of this active policing through governmental inspection, free riders trying to avoid the legally obliged certification have been minimised.

1.1.7 Technical Complexity of the Scheme

The regulations are focussed on the improvement of design, and the handling for installation and maintenance of an installation. To ensure co-operation, industry was involved in the discussions on the final regulations. An obligatory preventive emission control regime was defined: for installations with more than 3 kilograms of refrigerants, there had to be an annual preventive control, mounting to a monthly control and a permanent detection regime for installations with over 1000 kg. This prevention program has proven to be effective. In many cases the owner has benefited through improved service delivery and reduced costs instead of breakdowns.

Every installation in the Netherlands with a content of refrigerants of more than 3 kilograms has a logbook. In this logbook the handling with refrigerants are administered, both by the amounts used as well as the reparations or service handling carried out. The owner of the installations is responsible for his logbook. The amounts of refrigerants are entered in the administration log of the engineer as well. Because of the administration of refrigerants it is possible to generate more accurate figures on emission rates.

1.1.8 Impact

In total 1.4 million refrigeration and air-conditioning installations are installed and being maintained by STEK-certified companies. 2400 companies and organizations had been approved by STEK by January 2001. However, the STEK scheme necessarily entails a degree of paperwork and it is estimated by STEK that around 150 smaller companies (i.e. around 5%) ceased trading in the refrigeration sector due to the implementation of STEK. It is not recorded what happened to these businesses.

On the positive side, the system has reduced leakage to an average of 4.5% p.a., with the greatest leakages now in the industrial sector. STEKs own research indicates that 92% of the installations had no emissions at all in the reference year 1999, i.e. 8% of the installations cause all emissions.

1.1.9 Further Developments

From leakage rates at the level of 30% at the early 90's (according to STEKs estimates, and a level we believe to be indicative of most of the EU at that time), emissions have been reduced to around 5%. Our experience suggests that current leakage rates in non STEK countries are likely to be nearer to 15%[4], although in business as usual this should fall by 2012 due to some older plant being retired. (For the purpose of our analysis we have assumed an 11% leakage rate by 2012, this is clarified in section 2).

To reduce leakage rates still further, developments under consideration by the Dutch government include the consideration of setting mandated maximum leak rates, possibly per contractor rather than per installation. There is also some feeling that the STEK organisation should face competition, to reduce costs and to avoid the danger of it taking on more than its statutory obligations. Registration is not a precondition for purchase of refrigerants under STEK.

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4 The base assumption used in the ECCP study

1.2 Comparison to Current Member State Policy

During the study all 15 member states were contacted in order to determine their progress in applying regulation 2037/2000 and their intentions (if any) in applying regulations to the use of F gases. This research has revealed a very mixed picture. The responses of the individual Governments are reviewed in detail in Appendix A1 and are summarised in the table below:

Table 1: Regulatory Infrastructure in each country covering F gases:

Country	Regulatory Infrastructure	Industry Size and number of Registrants	"STEK Factor"
Austria	Waste Management Acts. State certification, with local authority	7-8 large companies, 700 installations	0.05
Belgium	Federal & Regional legislation Adequate waste legislation	1100 companies 6800 personnel	0.5
Denmark	KMO Agreement	600-700 companies, 225 installation co.s, 1500-2000 personnel (100 domestic)	0.25
Finland	Administration: The Safety Technology Authority. Certification: Vocational qualification committees	500 for min. requirements, total: 600 Roughly 2-3000 personnel	1
France	Regulations	2200 companies, 18000 workforce, 3000 installation personnel.	1
Germany	VDKF guidelines Dual System of Education Master Craftsmen – Meister in Handwerk	2600 refrigeration and a/c firms, 20000 workforce, 90 m refrigeration plants, 10 foam manufacturers	1
Greece	Certification system, technical requirements and partial monitoring and auditing in place	350 companies and 4000 workforce.	2
Ireland	No response		1
Italy	Waste Managements Acts. Specific decrees under development.	15000 in industrial AC 10000 in industrial and commercial refrigeration	1.5
Luxembourg	No response		0.75
Netherlands	STEK	Installations: 2400 7500 certified engineers	0
Portugal	Under development	400 – 1200 companies, 5000 workforce	2
Sweden	*Ordinance on HFCs (SFS 1995:555) –, The Refrigerants Order (SNFS 1997:3),* Order (SNFS 1993:7 "Fire Extinguishers Order"	Accredited Co's – refrigeration sector: ~1100, Certified personnel – refrigeration sector: ~6000	0.5[5]
Spain	Waste Management Acts. Refrigerant installations regulations + technical ordinances. License for installers	9000 installers Roughly, 15000 personnel	0.5
UK	ACRIB	100,000[6]	1

[5] Swedish EPA felt this figure was on the high side but we have been unable to agree a new factor.

1.2.1 The STEK Factor

It is clear that there are many similarities and differences between the countries investigated. The main similarities are driven by European policy. These include the implementation of regulation 2037/2000 which is taking place slower than anticipated but which should be largely in place by the end of 2003. Other European regulations including WEEE, IPPC and the ELV directive will also provide extra coverage of F gas usage in domestic refrigeration, gas manufacture and MAC. However it is clear that there are also many differences in each country and this has lead us to propose a "STEK factor" for each country which will be used later to help calculate the costs for each country to implement STEK. This factor is a straight forward "multiplier" to the costs involved to implement STEK compared to those noted in the Dutch experience. Thus the Netherlands itself has a STEK factor of zero since there are no additional costs from the current position. A country with a similar situation as to the Netherlands but with no STEK regulations in place has a factor of 1 and a country with a STEK factor of 2 such as Greece is in a situation where much additional work will be required to educate industry.

The allocation of a STEK factor to an individual country is subjective and therefore likely to be contentious. Our allocation is based on our interviews with Government and Industry in each country. Factors taken into account include:

- Individual policy in countries including regulations in some countries, such as Denmark, banning F gas usage implies a reduction of STEK factor because this is regulation on the industry in its use of F gas

- On the other hand some countries such as France have gone for taxation of F gases – this is not included in STEK and therefore does not imply in itself a lowering of the STEK value

In section 2 we use this to estimate the likely costs for each member state in applying STEK. It should be noted that our calculations are entirely transparent and any country wishing to rebase its calculations can do so with ease if required.

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6 This figure appears high compared to other countries – perhaps due to a large number of "part time staff" who would not actually register and we have therefore taken a lower figure of 60,000 in our calculations.

2. COST EFFECTIVENESS CALCULATIONS

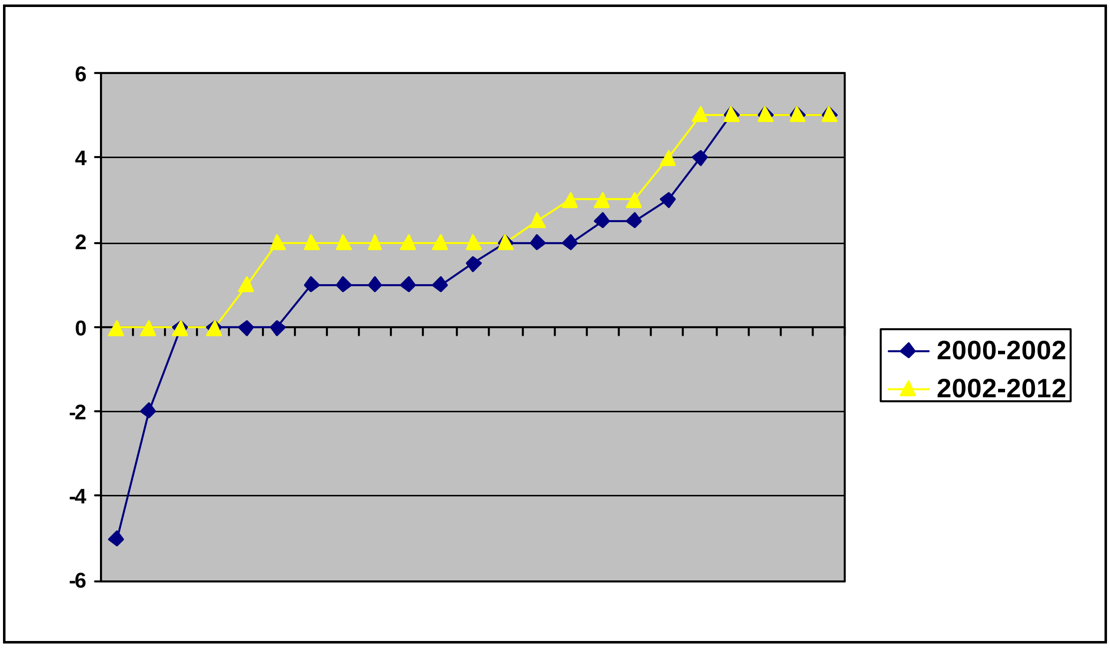
To calculate the cost effectiveness of a measure to reduce emissions it is necessary to estimate the reduction in emissions achieved (over a set timescale) and the expenditure required to achieve these reductions. In the next two sections our analysis for estimating these two factors is set out. It is important to note that our assumed timescale for emissions reduction, as consistent with the ECCP analysis, is the Kyoto timeframe of 2008 to 2012.

2.1 Estimating the Impact of STEK on Emissions

The starting point for estimating emissions reductions achievable is to establish the baseline (often referred to as Business As Usual) emissions expected. As noted earlier, we followed the work performed in the ECCP study closely. This suggested that leakage rates from RAC in the year 2000 were around 15%. In our earlier ECCP work we projected that under the "Business As Usual" scenario leakage rates for 2012 would fall to around 12% p.a.

In this study to validate this figure we interviewed 32 refrigeration contractors. The contractors were asked to estimate the reduction in leakage rates achieved over the past 2 years and to estimate what further reductions could be achieved under business as usual by 2012. Whilst it is noted that 32 is a small data set, the data received from these contractors was added to the information gained in the recent ECCP and other study to build a continuing picture of refrigeration leakage rates across the EU. In total this provides information gained in the last two years from around 200 contractors. The contractors gave a range of estimates for leakage rate reductions as shown in Figure 1 below:

Figure 1: Contractors estimates of refrigeration leakage reduction rate from 2000 to 2002 and from 2002 to 2012



In the STEK experience we have seen that the leakage rate achievable ***in all these installations*** could be reduced to 4.5% by 2012. We believe that over the whole EU this is a slightly optimistic figure due to national variations and the fact that STEK has been running for 10 years in the Netherlands. Other factors distinctive to the Dutch system are the small size of the industry, the centralised government and the renowned high levels of cooperation between industry and government. Hence we have taken a central estimate for leakage rate reduction achievable under STEK to be 5.5%, since STEK has been running for 10 years in the Netherlands and other countries would take time to "catch up".

The estimates for leakage reduction achievable detailed above are based on the year 2012. Our cost analysis is for the period 2008 to 2012 and thus we have also estimated the "phase in period" for these reductions to be achieved. Since the reduction in emissions will increase as the systems adopted becoming more widely applied and as the use of HFC refrigerants grow. This phasing in is detailed in table 2 below:

Table 2: Phasing In of Emission Savings

Year	% of 2012 emission saving
Up to 2005	0
2006	5
2007	15
2008	35
2009	70
2010	90
2011 and beyond	100

It is assumed that the scheme would be rolled out across Europe in 2005. Thus savings commence at a very low level in 2005 (essentially zero). By 2008 (the start of the Kyoto period, savings will only be 35% of those estimated for 2012).

In our analysis we interviewed contractors and Government representatives to estimate the regional variation in emissions both for now and for Business As Usual in 2012. These interviews are summaries in Appendix A2 and are detailed (where confidentiality allows) in their entirety in Appendix A4. From these interviews the business as usual leakage rates have been estimated and from this the leakage reduction achievable through STEK can then be calculated for each country.

Our estimates for the potential emission reductions achievable in 2012 through the implementation of STEK on a country by country basis in tonnes CO_2 equiv. are summarised in table 3 below. This shows that BAU emissions are expected to be 35.1 M tonnes CO_2 equiv across the EU in 2012 and that a reduction of around 15 M tonnes CO_2 equiv is achievable through STEK.

Table 3: Emission Reduction Potential by Country from RAC

Country	BAU Leakage rate p.a.	Leakage rate p.a. under STEK	Total BAU leakage in 2012 (tonnes CO_2 equiv.)	STEK Leakage reduction achievable in 2012 (tonnes CO_2 equiv.)
Austria	8%	5.5%	850,672	265,835
Belgium	8%	5.5%	1,031,298	322,281
Denmark	12%	5.5%	732,928	397,002
Finland	13%	5.5%	546,799	315,461
France	9%	5.5%	5,833,748	2,268,680
Germany	9%	5.5%	8,411,636	3,271,192
Greece	15%	5.5%	510,736	323,466
Ireland	15%	5.5%	429,690	272,137
Italy	13%	5.5%	4,840,822	2,792,782
Luxembourg	9%	5.5%	86,935	33,808
Netherlands	4.8%	4.5%	1,665,642	n/a
Portugal	15%	5.5%	478,631	303,133
Spain	15%	5.5%	2,528,170	1,601,174
Sweden	9%	5.5%	736,000	286,222
UK	9%	5.5%	6,428,130	2,499,828
Total	**11%**	**5.5%**	**35,111,837**	**4,690,357**

Note that the BAU leakage rates used are those predicted by the individual country. Where no estimate has been made a default rate of 15% has been assumed.

2.2 Estimating the Costs of Implementing STEK

Having made estimates for the possible emission reductions achievable it is necessary to consider the costs likely to be incurred. To estimate the "additional costs to business as usual" is a difficult task given that there is little empirical data available and is further complicated because the factors used to estimate costs will be different in each country based on current and future legislation. Where possible we have based estimates on the STEK experience as this provides real cost data. However it is difficult to identify the full additional burden placed on industry even in the STEK experience since the regulation has incurred costs such as additional time, equipment and training which have not been monitored and are never clear cut. The next sections describe our methodology for estimating costs on a country by country basis, based on the information provided in section 1.

In Section 1.1 we saw that STEK estimate the total costs to set up and run their system in the Netherlands are around € 18.75 m and € 5.4 m respectively. The factors that determined the costs of the system in the Netherlands and therefore determine how this will vary from country to country were:

- Installed base of RAC equipment
- Number of refrigeration contractors

- Number of companies operating
- Status of existing legislation

Without performing a major research study it is difficult to precisely estimate the installed refrigeration base in each country. We have therefore assumed that this will be proportional to GDP. The number of contractors and companies has been determined through desk and telephone research and the current status of legislation has been determined by telephone research of the individual Governments involved. We saw in 1.1 that the set up costs in the Netherlands were as follows:

Total Set Up Cost:

Govt set up cost	€750,000
Training Cost	€18,000,000
Total Cost	€18,750,000

To apply this to other countries we have assumed that these can be calculated as follows:

Government set up costs are taken to be proportional to population size. As the population of the Netherlands is 15 million this becomes – ((0.75m € / 15 m) * population) i.e. 0.05 * Country population

Training costs are €363 plus 5 man days (at each countries man day rate[7]) for each contractor.

In addition, as noted earlier we have added a "STEK" factor which notes how close a country already is to having STEK like policy in place and hence will have less additional costs to fund.

Thus the formula used for set up costs is:

(0.05 * Country population + (€363 + 5 *man day rate) no of contactors) * "Stek Factor"

Total Running Cost:

For the running costs in the Netherlands the factors were as follows:

Additional Labour cost	**one man day per contractor**
Annual Registration	**730€ * No of companies**
Training Cost	**5% of the annual training costs above**

Annual registration is €730 for each company in the country

Thus the formula used for running costs is:

(1 *man day rate * no of contactors + 730 * No of companies + 5% of training costs) * "Stek Factor"

[7] For man day rates we have taken the UK man day rate of €400 per day and increased or decreased this in line with wage data taken from "International Comparison of hourly compensation costs for production workers 2000" – US Dept of Labour.

Table 4 documents the calculation for each country:

Table 4: Set up and running cost estimates for STEK on a country by country basis:

Country	STEK	
	Set Up €M	Running Costs €M p.a.
Austria	1	0.4
Belgium[8]	10	2.7
Denmark	7	1.8
Finland	9	2.3
France	64	15.0
Germany	106	25.1
Greece	40	10.4
Ireland	7	1.9
Italy	104	35.9
Luxembourg	1	0.3
Netherlands	18	5.4
Portugal	11	3.4
Spain	42	18.0
Sweden	9	2.3
UK	145	38.4

Note the set up costs for NL are for comparison only – they have already been spent.

2.3 Cost Effectiveness and Sensitivity Analysis

Having estimated the costs and potential benefits it is now possible to look at the potential "cost effectiveness" achievable. To ensure consistency with earlier analyses we have attempted to calculate the cost benefit using the same assumptions as those used in the ECCP report, namely that cost of capital is 4% and that the "timeframe for emissions reductions" is 2008 to 2012. In addition we have amortised the set up costs over a 15 year period. In the tables below it can be seen that cost estimates to establish such a system vary by country and not just due to population effects. Some countries such as Belgium and Austria (as reflected by our STEK factor) are quite close to having much of the infrastructure necessary already in place whilst others are much further away. Table 5 below details our central estimates for the cost effectiveness of these measures.

8 We would note that the data on Belgium has changed substantially from earlier draft versions of this study due to the provision of accurate Belgian market data from the Belgian Government

Table 5: Emission reduction Potential and Cost Effectiveness by Country[9]

Country	BAU RAC leakage p.a. (in 2012)	STEK Leakage reduction achievable in 2012	STEK average Cost Effectiveness €/tonne CO_2 equiv.
Austria	850,672	265,835	2.31
Belgium	1,031,298	322,281	13.98
Denmark	732,928	397,002	7.60
Finland	546,799	315,461	12.14
France	5,833,748	2,268,680	11.28
Germany	8,411,636	3,271,192	13.05
Greece	510,736	323,466	53.31
Ireland	429,690	272,137	11.34
Italy	4,840,822	2,792,782	19.88
Luxembourg	86,935	33,808	12.49
Netherlands	1,665,642		
Portugal	478,631	303,133	17.76
Spain	2,528,170	1,601,174	16.68
Sweden	736,000	286,222	13.55
UK	6,428,130	2,499,828	25.32
Total	**35,111,837**	**14,953,001**	**18.32**

Table 5 shows that the application of a STEK regulatory system across the EU could result in the saving of 15 Mtonnes CO_2 equivalent per annum of emissions by the year 2012. These savings would be achieved at an average cost of under 20 Euros per tonne. In fact, only in Greece does the national cost seem high.

9 It should be noted that leakage rates are assumed to have "levelled out" by 2010 and thus leakage rates in 2010 are broadly the same as in 2012

3. IMPACT ON INDUSTRY - RAC SECTOR

During the course of the study we interviewed industry representatives from across Europe as to the possible implications of imposing regulation on the control of leakage of F gas from equipment.

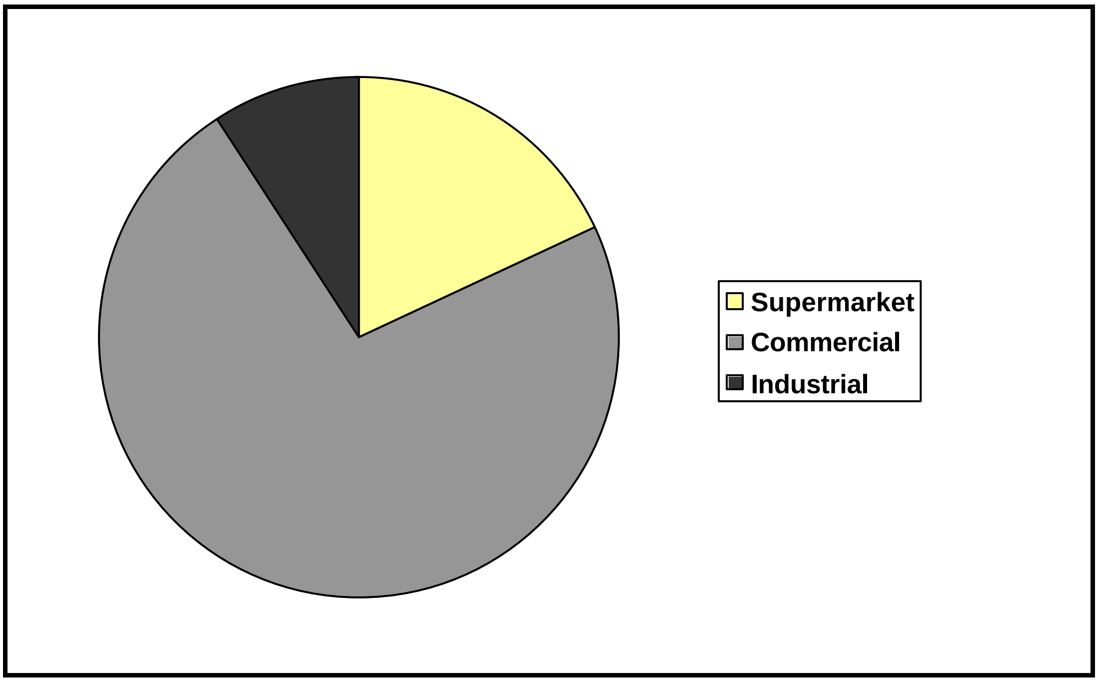
However it is important to take into consideration that, as is often unavoidable with studies of this nature, the majority of contacts and respondents do not represent "small" companies. This includes trade associations, which many small firms do not to join, and, as highlighted by a representative of FETA, these associations often have difficultly in communicating important information to.

The main reasons noted for leakage in the refrigeration sector were mechanical damage and vibration leading to leaking joints, too long between service periods, a need for culture change and training of staff and a need for taxation of gas to make leakage more costly.

Any costs imposed by a new framework would inevitably be passed on to the end user. The end users most affected would be those with major spend on maintenance. Most of these industries do not compete outside of Europe and so little disadvantage would occur for the bulk of users (Retailers, Supermarkets, and Commercial premises). Two industries which could be disadvantaged in international trade are the Chemical sector and the food and drink sector. However, the marginal additional cost to these sectors would be quite low.

In a recent study of the EU contracting market[10] the Chemical and Food and Drink sectors comprised less than 10% of the total contracting market (see Fig 2 below). Thus the cost borne by industry would be relatively low in comparison to the costs borne by the retail trade.

Figure 2: Percentage of EU Contracting Market by Sector



[10] Enviros study for a private client - 2001

Industry note that other regulations including WEEE, IPPC and the ELV directive will provide extra coverage of emission reduction policy in some sectors (domestic refrigeration, gas manufacture and MAC)

Some concern has been expressed at the continued use of disposable containers by parts of the RAC industry. These containers hold 13.6kg of refrigerant and are not returned for recycling or destruction. The concern is therefore that these containers still hold a significant "heel" of gas when they are disposed of. For the EU motor industry, use of disposables in 2002 will be around 100,000 units. At 13.6 kg each this equates to over 1,360 tonnes of refrigerant. If on average around 2% remains as a "heel" (i.e. less than 0.4 kg per cylinder, which is the point at which all liquid has gone) then this will result in the eventual emission of 27 tonnes of 134a. We have not been able to obtain similar market estimates for the non auto disposable market, but disposables are advertised in a range of non-auto trade magazines. Practices vary widely across Europe, but we would estimate that overall, the non auto market may be of similar size to the auto market thus resulting in an additional 27 tonnes of emissions. This gives an overall figure of around 55 tonnes of 134a or 70,000 tonnes CO_2 equivalent. These emissions could be reduced if disposables were banned. This would allow much greater traceability of refrigerant gas and would also be a popular move with the refrigerant manufacturing industry. There is good support from industry for a ban on the use of "disposables". This could save an additional 0.07 Mtonnes CO_2 per annum.

4. NON RAC SECTORS

In addition to gathering emissions data and attitudes toward regulation in the RAC sector we have also interviewed representatives from the other sectors which use or emit F gases. Their responses are summarised below. In considering the applicability of similar regulatory frameworks to the non refrigeration sectors it is useful to consider how "similar" the applications are to refrigeration. The characteristic use of F gas as a refrigerant is that the gas is placed into a sealed system at manufacture. The gas may be topped up during the equipment lifetime (several years) and the gas may be recovered at end of product life. This is also the case for the use of F gases in gas insulated switchgear and fire fighting systems. However, for solvent use, foam blowing, magnesium smelting and F gas manufacture, the usage of F gases is totally different. These sectors are therefore not considered within this report.

Gas Insulated Switchgear (GIS): Most of the emissions from GIS, (about 7.5% of the total equipment charge), occur during pre-sale testing and installation. These emissions have fallen from 10-20% due to new methods used in testing. Five large manufacturers cover the EU market and therefore could be included in negotiations prior to a Voluntary Agreement or regulation relatively easily. All five are members of the trade association CAPIEL.

Very little gas is lost over the average lifetime of 30 years, 0.1-1% per year. If larger losses occur this is identified since the equipment would then fail to operate. Whilst it is possible to top up the high voltage GIS used in national grid systems across Europe (approximately 3,000 installations) it is not generally possible to top up the fluid in "lower voltage" equipment. In addition to national electricity distribution users, GIS is also used by "heavy" industry. This accounts for around 10% of use and it is in this sector that STEK might have some impact. However the impact would be small (around 15% per annum leakage reduction) and the cost will be large since there are many users (perhaps 10,000). In addition, the lower voltage GIS is generally hermetically sealed and therefore leakage results in "catastrophic failure". Failure rate is currently low and hence it is felt that emissions rates are similarly low.

If STEK were to be applied to GIS it would need to cover around 50 major contractors and around 1,000 individuals who operate with this equipment. Assuming that registration and training costs are similar to those for RAC and a STEK factor of 2 since no relevant legislation or infrastructure is currently in place then this implies set up costs of €8m and running costs of around €1.5m per annum. With emission reduction savings likely to be no better than 2% per annum this gives a cost effectiveness of €58.62 per tonne.

Currently a new monitoring methodology is being considered at an IPPC level, based on mass balance calculations and documenting purchasing and delivery notes, which are reported to authorities. IPPC should therefore be successful in controlling most of the emissions from this industry. As noted in the ECCP study voluntary action is already underway and official recognition of this action by the commission is being sought.

Fire fighting: The fire fighting industry consists of a relatively small number of system suppliers (around 30-50 in the EU) and a larger number of installation and service companies. Current leakage rates for halon systems are estimated by the UNEP HTOC at about 5% p.a. of the installed quantities. Where new systems have been designed for HFCs it is believed emission rates can probably be reduced to half this level. This reduction requires industry action, which it seems in general ready to take in co-operation with government. In the UK there is already a voluntary scheme (approved by DEFRA), very similar to STEK, which deals with halon decommissioning. It involves the registration of firms, the certification of personnel through exams by UKAS accredited bodies, random verification visits and auditing of use. BAFE training for this certification currently costs €880 and the FETA exam €230. A scheme like this could be expanded to include fluorinated gases but there is limited support for a mandatory scheme. Industry instead is advocating voluntary agreements, with an independent board of control representing all stakeholders.

Overall fire protection is seen as a non-emissive application (except in the event of a fire or unwarranted emission). The introduction of regulation 2037/2000 has been unpopular in some quarters since, as it has banned recycling of halon it has eliminated the economic incentive to capture rather than emit the gas. This is suspected to have lead to some bad behaviour in the industry. It is seen as a prerequisite for any F gas regulation that the ability to recycle F gas is enshrined as permanently acceptable. This in turn requires that users are not required to replace their systems before the end of their useful life (a sentiment echoed by many respondents in other sectors).

If STEK were to be applied to fire fighting it would need to cover around 50 major contractors and around 3,000 individuals who operate with this equipment. Assuming that registration and training costs are similar to those for RAC and a STEK factor of 2 since no legislation or infrastructure is currently in place then this implies set up costs of €19m and running costs of around €4m per annum. With emission reduction savings likely to be no better than 2% per annum this gives a cost effectiveness of €35.99 per tonne.

As with GIS a voluntary agreement with the industry should be relatively straight forward to establish given the small number of major players. The potential for reducing emissions using STEK in non RAC sectors is summarised in table 6. It should be noted that we used a population factor in the RAC calculations to represent legislation set up costs in each country. This does not seem appropriate for GIS and firefighting and we have assumed that an EU wide system for firefighting or GIS would cost twice as much to develop as the Netherlands only STEK system.

Table 6: Emissions reductions from STEK in GIS and Firefighting

Sector	BAU RAC leakage p.a. (in 2012)	STEK Leakage reduction achievable in 2012	STEK average Cost Effectiveness €/tonne CO_2 equiv.
GIS	4,700,000	47,000	58.62
Fire-fighting	500,000	200,000	35.99

5. CONCLUSIONS

This report summarises research performed in January to May 2002 to assess the current regulatory frameworks in place in each member state and the costs and potential benefits of applying new regulations to the use of "F gases" across the EU. Views have been sought from Government, Industry (gas and equipment manufacturers, contractors and end-users) and NGOs. Over 100 interviews have been conducted and the information collected has been analysed in conjunction with the findings from the ECCP study completed last year. There were three main objectives to our study:

a) Review STEK (STEK is used as shorthand for the Dutch system of F gas regulation) and compare to member state policy, in the context of regulation 2037/2000.

b) Assess Cost Implications and emissions reductions potential

c) Identify effects on the public and private economy.

All our emission reduction estimates are based on the Business As Usual Scenario projected in the ECCP report since these have been generally accepted by both the commission and industry. Our main findings are as follows:

5.1 STEK

- Stek is well known to the refrigeration industry and other major stakeholders

- Stek has been highly successful in the Netherlands in both minimising average leakage rates and in virtually eliminating "rogue traders", reducing equipment leakage rate to 4.5% p.a. compared to a European average of 15%

- In its current form, Stek is seen as technically and bureaucratically onerous on industry. It is prescriptive to a very high level of detail and it also requires a high level of record keeping. These increased demands place added cost on industry and have resulted in the closure of some smaller firms and have added cost in the remaining businesses.

- STEK provides additional benefits to industry through improved energy efficiency and improved process and quality control.

5.1.1 Cost Implications & Emission Reduction Potential

- To establish the cost of the regulatory framework, desk research and interviews were conducted to estimate the likely costs and potential leakage reductions achievable.

- To establish regulation costs, the costs of establishing current systems were obtained from Government Departments. Costs to establish future systems were then extrapolated based on population, gdp, refrigeration usage, numbers of refrigeration companies and contractors, labour costs and the status of current legislation.

- To establish trends in refrigeration leakage rates, over 40 refrigeration contractors were interviewed. Information gained was combined with that used in the earlier ECCP report

- The emissions cost effectiveness for STEK have been estimated as follows:

Regulation	Total Annual Saving in 2012 Mtonnes CO_2 equiv.	Average Cost effectiveness per Tonne (Euros)
STEK	15.0	18.32

5.1.2 Impact on Industry

- A full blown STEK system would result in the closure of some smaller refrigeration contractors adversely affecting companies with many small contractors such as the UK and Italy

- Other regulations including WEEE, IPPC and the ELV directive will provide extra coverage of emission reduction policy in some sectors (domestic refrigeration, gas manufacture and MAC)

APPENDICES

1. GOVERNMENT POLICY ON F GAS

In our research we contacted the 15 separate EU National Government Departments between January and March 2002 to check what level of infrastructure already exists to enable a potential "fast track" approach to implementing STEK. It should be noted that the information below is only current as of March 2002. Responses were received from all countries with the exception of Luxembourg and Ireland. The results are reviewed for each country in turn and are summarised in table 1.1 in the main report.

Austria: An ordinance on refrigerant installations, refilling and leakages was implemented in 1969 and updated in 1994. This details regular services (annually) by trained technicians, and requires a logbook to be kept for equipment over 5 kg which is checked by the authorities. Recovery is compulsory under the Waste Management Act of 1989 and the standards for personnel, by a state run exam, under the subsequent Act of 2000.

We therefore estimate that because of these existing requirements, the cost to Government in Austria to establish a Regulatory system would be low and it would be relatively quick to implement.

Belgium: An active fridge destruction and toxic waste policy is already in place. A comprehensive model has been completed for a certification and qualification regime, the outcome of working with the trade federations, but to be run by regional authorities. In the Flemish region there is already comprehensive environmental legislation but a certification programme is still under development. There is also a levy on the purchase of 'white goods', of about €20/unit. Belgian installation personnel are already affected by STEK, and some personnel in the North have taken a qualification, with STEK supervision, so that they can operate in the Netherlands.

We therefore estimate that the cost to Government in Belgium to establish a regulatory system would be lower than average with a STEK factor of 0.5. However, since STEK already effectively exists in some of the country, the gains achievable will also be lower.

Denmark: The Danish Ministry of Education has run an education system for cooling and heating and a system of annual checks (including containers of less than 3kg) by qualified personnel for many years (since 1950). Since 1992 there has been a voluntary agreement, The Environmental Refrigerant System (KMO), dealing with recovery and also the registration of companies and employees, mandatory for F gas purchases. Newcomers have official education and follow up tests. From March 1st 2001 there has also been a tax on all F gases (except SF_6) of around € 40/kg.

As many of the large companies are already effectively "fully registered" costs for implementing a full STEK system in Denmark are likely to be low.

Finland: There are current regulations on recovery of hazardous waste, including refrigerants (1998). In December 2001 regulations were implemented on minimum qualifications required for installers and service personnel. There are also some enforced check-ups on equipment over 3kg. However not all service personnel have had the opportunity to take exams yet, as there will be a transition period of two years. There are no prescriptive technical requirements in the current regulations, this is one of the main differences STEK which is more detailed than the Finnish scheme. The current scheme cost €50,000-70,000 for the Government to establish.

France: Two regulations have been in place since 1992 for refrigeration equipment containing over 2 kg of refrigerant. The first concerning the qualifications necessary to handle fluids, personnel are registered by local authorities, and the second governing the recovery and handling of equipment. In 1998 a health and safety regulation was introduced including minimum requirements for equipment and an annual obligation to detect leakages and repair any that are found. A new national programme was approved in 2000, intended to be active by the end of 2002. This contains two levels of regulations, one which extends regulations to all amounts of refrigeration fluid charge (with more detailed requirements for systems over 3kg) and one concerning qualifications, control, leakages and recovery in mobile air-conditioning. It also includes measures to forbid the sale of fluids to those without minimum qualifications.

We therefore estimate that the cost to Government in France to establish a Regulatory system would be low and it would be relatively quick to implement.

Germany: A regulation from 1991, dealing with halons and CFCs (Article 8), prohibits the escape of these gases during operation, maintenance or at end of life and includes obligations for recovery and specifies relevant expertise and technical equipment for those handling gases. The German Federal Ministry for Economy and Technology and the Federal Ministry for Environment are discussing a proposal is to be issued by the end of 2002, which is likely to amend existing regulations to include HFCs and also the possibility of further adapting regulations to include PFCs and SF_6 . Some technical requirements may also be included plus further regulations on the competence of personnel. Problems with this previous article have been that the Federal Landau does not have the personnel to control its implementation, plus the regulations are unclear on requirements for owners of equipment.

A voluntary qualification system, and guidelines for testing the leakproofness of stationary refrigeration and air-conditioning equipment have been developed by the German contractors association (VDKF), for HFCs and CFCs equipment with a charge of more than 3kg. The VDKF has a membership of 1,200 firms (of the 2,600 refrigeration contractors), employing 16,000 (of the 20,000) workers, these firms account for about 80% of the annual gross volume (source: VDKF). The average cost to companies of the dual education system run by the VDKF per year, over 3 years, is about €20,000. Part of the dual system of education is vocational training, The Master Craftsmen – Meister in Handwerk has a training period of 3- 3.5 years with examination. This qualification is required to set up or take over a business, for managerial positions and for training others.

Greece: No information has been provided yet by the Hellenic Ministry of the Environment. Information was provided by the AREA national member, APIRA (Association of Professional Installers of Refrigeration and Air conditioning of Greece). They stated that certification of installers already exists in Greece, as do technical requirements. There is also a partially applied system of monitoring and auditing.

Ireland: No information was provided.

Italy: Recovery of CFCs (but not HFCs) is controlled under Italian waste regulations (Law 549/93 modified by law 179/97, and Decree 3 October 2001. Currently, the government is working together with trade associations to prepare three decrees that will contain 1) qualification requirements and leakages from installations (programme of course, minimum skills, qualifying examinations and release of a license, periodicity of checks, handbook of installations, 2) recovery from domestic installations; and 3) recovery from industrial installations. The implementation of these decrees is foreseen by the end of this year (2002).

We therefore estimate that the cost to Government in Italy to establish a Regulatory system would be moderate (extending CFC legislation to cover HFCs) however it would require more effort and time to properly enforce than in some other countries.

Luxembourg: No information was provided..

Netherlands: Since 1991 the STEK organisation has administrated the certification of refrigerant engineers, it also registers companies and equipment. Legislation, with specific penalties, was also introduced detailing maximum leakage rates, the use of certified installers, preventative maintenance measures, technical requirements (RLK) and use of logbooks to record any handling, this legislation is enforced by a government inspectorate. The RLK specifies around 40 pages of technical requirements that manufacturers must adhere to for equipment over 500 Watts. Clearly there are no additional costs or benefits of STEK to be borne by the Netherlands Government.

There are, however, current discussions about a rationalised scheme intended to be 50% cheaper, as the current cost of STEK, € 2.6m p.a. in registration fees paid to STEK by 2000 installation firms, is seen as too expensive. Current government also wants phase out the RLK requirements as these are believed to hinder technological innovation. The requirements have been updated occasionally but they are now seen as having performed the task for which they were intended and that focus should now be on actual emissions, for example giving emission targets to large installations and issuing performance standard rates. These policies will probably be finalised in the next 6 months and be up and running in the 1½ years, intended to coincide with the EU framework directive.

Portugal: A regulation on the recovery of CFCs is being developed within the Ministry of Environment and Land Use Planning. This regulation shall assign to users, refrigeration technicians or other appropriate bodies responsibility for ensuring compliance. In addition, a task force between different ministries and professional associations was created in order to define minimum qualification requirements for the personnel involved for the purposes of Articles 16 and 17. All these initiatives are delayed as a consequence of the Government change after last elections.

We therefore estimate that the cost to Government in Portugal to establish a Regulatory system would be considerable and it will take a relatively long period of time to introduce and enforce this legislation.

Spain: Recovery of CFCs (but not HFCs) and fridge destruction is controlled under Spanish and Autonomous Communities regulations, and authorized companies and treatment plants exist. The regulation on safety of refrigeration installations was established under Royal Decree 3099/1977. Specific technical ordinances have progressively developed this regulation, some of them referring the authorization to use alternative refrigerants after the adoption of the Montreal Protocol, and covering maintenance of installations, leakage prevention, etc. Currently, installers are given a license by the competent authorities in each Autonomous Community, after completing an examination (160 hours). Nevertheless, lack of enforcement of existing law is a critical issue in Spain.

We therefore estimate that the cost to Government in Spain to establish a Regulatory system would be moderate (extending CFC legislation to cover HFCs) however it would require more effort and time to properly enforce than in some other countries.

Sweden: HFCs are covered in the national legislation on refrigerants, the "Refrigerants Order". Servicing and installation of refrigeration and air-conditioning systems may only be carried out by accredited enterprises, these must have certified and trained personnel (re-examination every 5 years) and are liable for audit. There are technical requirements on design (safety and sealing valves, signs detailing refrigerant, charge, maximum pressure etc.), plus an operating manual and further specifications. Plus requirements on inspection, record keeping and reporting, upon installation (all refrigeration and air-conditioning systems except unitary stationary systems with less than 3kg refrigerant). The Swedish Refrigeration Association has a code of how often a system may leak, and what should be checked. For plant owners of equipment of more than 10kg it is mandatory to report the outcome of check-ups. The export of recovered HFCs requires a permit by the Swedish EPA. The government is also currently drafting a climate strategy, due next autumn, that will comprise a national target for reductions of greenhouse gas emissions, and will include fluorinated gases. We therefore estimate that the cost to Government in Sweden to establish STEK would be low and it would be relatively quick to implement.

UK: In the UK Climate Change Programme (UKCCP), the Government set out the four key elements of its position on the future of HFCs:-

- HFCs should only be used where other safe, technically feasible, cost effective and more environmentally acceptable alternatives do not exist;
- HFCs are not sustainable in the long term - the Government believes that continued technological developments will mean that HFCs may eventually be able to be replaced in applications where they are used;
- HFC emission reduction strategies should not undermine commitments to phase out ozone-depleting substances under the Montreal Protocol;
- HFC emissions will not be allowed to rise unchecked.

Pending EU wide action, the Government is taking a number of steps with the refrigeration and air conditioning sectors and other users of HFCs. In the UKCCP, the definition of minimum qualifications for people who handle refrigerants including HFCs was proposed. The industry is now developing a national registration scheme for refrigeration handlers. By setting minimum competence standards, this will help limit emissions of refrigerants. Once a final agreed framework from industry has been sent to Government, the UK proposes – with industry support - to introduce legislation to make the scheme mandatory. A scheme would also cover personnel handling mobile air-conditioning systems and engineers servicing fire-fighting equipment. The UK also plans to ban the supply of HFC refrigerants in disposable containers.

ACRIB have identified likely costs to industry to be of the order of €40 million to register the entire industry. This is likely to take 2 to 3 years. These costs do not include the additional ongoing costs of extra monitoring, inspection and servicing required by end users, especially of larger equipment. These costs which will be of an ongoing nature are likely to be around €20 million per year for a full STEK system.

In addition to these costs are the costs of establishing independent validation and also the costs of monitoring and policing these activities

2. EMISSIONS REDUCTIONS ACHIEVABLE

We questioned the Government departments and Industry as to their views on the potential emissions savings which might be achieved in their countries. During the course of our study we contacted over 30 Government representatives to gather data, we also conducted around 70 interviews with Refrigeration Contractors, Equipment manufacturers, trade associations and end-users. Here we provided a detailed response from Government and Industry as to absolute emissions, emission rates and, where available, the likely leakage reductions achievable.

a) Government Response

Austria: In Austria, absolute emissions of HFCs[11] are expected to increase 156% from 0.779 million tonnes CO_2 equivalent, in 1998, to 2m tonnes, in 2008. SF_6 emissions are expected to increase 58% in the same period, from 0.31 million tonnes CO_2 equivalent to 0.49 m tonnes, and PFC emissions are expected to decrease by 98% from 0.97 m tonnes to 0.01 m tonnes. A total increase in emissions of 95% (Studie Unterberger, Federal Environment Agency Austria).

HFC leakage rates were approximately 15% in the refrigeration sector in 1995, 12% in 1998, and are predicted to fall to 8.5% by 2008. With STEK in place a level of around 5% may be achieved. Other substantial sources of emissions (1995) in Austria were the foam, semi-conductor, magnesium production (since phased out) and soundproofing industries. Emissions in the soundproofing industry are around 20% of total gas used. It is estimated in the foam industry that under business as usual (a 50% emission rate) emissions would increase from 255 to 306 tonnes, but this could be reduced to 47.6 Tonnes if the emission rate was reduced to 8%. Magnesium production since 1995 has largely switched to SO_2/nitrogen and is expected to be phased out completely by 2008 (Studie Unterberger, Federal Environment Agency Austria).

Belgium: Absolute HFC emissions are expected to increase by 283%, from 0.6 to 2.3 Mtonnes CO_2 equivalent, by 2010 under business-as-usual. PFC emissions are expected to increase from 0.0 to 0.3 Mt CO_2 equivalent and SF_6 emissions are expected to decrease 20.6% by 2010 (National Communication to UNFCC, July 2000)

Denmark: Total emissions in 1990 were 43 Kt CO_2 equivalent, expected to rise to 1432 Kt by 2010 under a business-as-usual scenario. It is anticipated however that with the tax on HFCs and PFCs, implemented in 2001, this total could be reduced to 837 Kt CO_2 equivalent in 2010 (Denmark's Greenhouse Gas Projections, April 2001). The emission rate for cooling is 17%, in the air conditioning sector it is 30%, in GIS it is 25%. The estimated average is 10-15% across all industries.

Finland: Emission rates in domestic refrigeration are 3.7% (2.7% during manufacturing and installation and 1% during use), for commercial refrigeration it is 22% (2.7% manufacturing etc., 20% use). Transport refrigeration rates are 33.1% (0.6% manufacture, 32.5% use), industrial refrigeration 17% (2% manufacture, 15% use), and stationary air-conditioning 10.7% (0.7% manufacturing, 10% use). Mobile air-conditioning 20.5% (0.5% manufacturing, 20% use). With commercial refrigeration accounting for the greatest actual emissions; 60,804 tonnes out of a total of 130,468 tonnes.

[11] All Country HFC estimates here include all uses (i.e. aerosols MDIs etc as well as RAC usage)

France: Absolute emissions of HFC have increased 930% from 258 t (of HFC) in 1990 to 2967 t in 2000. PFC emissions have decreased 41% from 452 t to 263 t. SF_6 emissions have increased 10%, from 90.9 t in 1990 to 97.6 t in 2000 (Air Emissions in France, Inventaire CITEPA 2001).

Annual emissions in the commercial refrigeration sector under business-as–usual are 30%, with 50% lost on disposal. Under the emission-reduction scenario of replacement of air-condensers with water condensers, the optimisation of secondary refrigerant systems and improvements in confinement and leaktightness inspection, emissions of remodelled equipment would be reduced to 15%. With the occurrence of "significant technological change concerning charge reduction", i.e. the charge halved, this could be reduced to 5%, though this hinders recovery leading to 85% emissions on disposal. Industrial emission rates could similarly be reduced from 20% (B.A.U scenario) to 10%, and MAC emissions from 15 to 10%. The business as usual scenario shows emissions of 12978 thousand tonnes of CO2 equivalent in 2010 compared to 6984 (46% reduction) under the first emission-reduction scenario and 3328 (74% reduction) under the further scenario. However, it should be noted that, due to some emission reduction efforts already made, the business-as-usual emissions are no longer realistic. (Report, Centre D'Energetique)

Germany: Emissions of HFCs were 3.13 million tonnes of CO_2 equivalent in 1995, and expected to increase, under a business-as-usual scenario, 534%, to 19.84 m tonnes, in 2010. PFC emissions are also predicted to increase from 1.76 m tonnes, 1995, to between 2.52 m tonnes by 2010. SF_6 emissions were 6.22m tonnes in 1995 and are expected to decrease 19%, to 5.01m tonnes, by 2010. This totals an increase in emissions of 150% under the business-as usual scenario. However the German Federal Environment Study, Oct 1999, anticipates in an emission-reduction scenario, that a "general mandatory maintenance for refrigeration and air-conditioning systems containing more than 1kg of refrigerant", could reduce emissions by 13%. They anticipate that this, along with other emission reduction policies (e.g. substitution) could reduce the total increase in emissions to only 34%.

Emissions in the commercial refrigeration sector are currently about 15% per year for new equipment and 20% for old, with a service life of 10 years. Emissions are approximately 5.5% in middle and large industrial refrigeration and air-conditioning, with a service life of 15-25 years, 2% emissions in room air-conditioners. MAC emissions are currently about 10% per year over a 12 year system life which corresponds to 120% total loss (two half refills and 20% maintenance loss), carbon dioxide is seen as a likely replacement in this sector, possibly by 2007. Foam blowing emissions are 7.5-100% in the first year, and 0.5%-1.5% subsequent annual loss, with a service life of 15-50 years. Other substantial sources of emissions in Germany are soundproof glazing, semiconductor manufacturing and aluminium smelting.

Greece: According to the Hellas Federation of Refrigeration and Greek AREA representatives APIRA current leakage rates are 10% with scope for a reduction to approximately 5%.

Ireland: No response as yet.

Italy: Emission rates in domestic refrigeration are 3.7% (3.0% during manufacturing and installation and 0.7% during operation), for small commercial systems it is 1.5% (0.5% manufacturing etc., 1.0% operation). Rates for systems for big commercial plants are 8% (3% manufacture, 5% operation), new cars 14% (4% manufacture, 10% operation), retrofitted cars 28% (8% manufacture, 20% operation), big chillers 13% (3% manufacture, 10% operation), foams 14.5% (10% manufacture, 4.5% operation), and GIS 7% (6% manufacture, 1% operation). Government assessments indicate a total bank of f-gases of 9480 tones, and a current annual usage of 3630 tones. Mobile air conditioners account for the 41% of bank and 39% of usage (see table below).

Sector	Bank	Current Usage
Industrial Refrigeration	1000 t	250 t
Commercial Refrigeration	1700 t	380 t
Domestic Refrigeration	2050 t	1400 t
Mobile Air Conditioners	3950 t	1450 t
GIS	780 t	110 t
Foam Manufacturing	N/A	N/A
Solvents		40 t
Fire-fighting	N/A	N/A

Portugal: F gas leakages rates used in the national inventory refer mainly (except for GIS) to the IPCC guidelines defaults. SF_6 annual leakages rates are based on data obtained from National Electric Network: 40kg/year, corresponding to an emission factor of 0.18%/year (current usage of 23676 kg).

Spain: According to data provided by government, emission rates in refrigeration are 10% (except for domestic refrigerators and freezers, which have 1% emissions), for GIS it is 2%, fire fighting 5%, aerosols 50% (year t) – 50% (year t-1), and passenger cars 20%. The main gas used is HFC-134a in the mobile air conditioning (bank of 7719 tones, current usage of 3011 tones) and in the refrigerating sector (bank of 4913 tones, usage 1632 t).

According to estimates of the industrial sector, considering phase-out of CFC/HCFC, an approximate HFC usage scenario for Spain in 5 years would be 60% of consumption in the refrigerating sector and 40% in foams (PU/XPS). In the refrigeration sector, 80% of consumption will be in mobile air conditioning, and 20% in industrial and commercial refrigeration.

Sweden: Estimates of emissions in the Swedish stationary refrigeration and AC sector are currently 6% p.a. loss (15% in 1990), and 1% loss at end of life, no figures for losses during production. Mobile Air Conditioning has an estimated loss of 1% at production, 11% p.a. (13% in 1990), with 8% of the total charge lost at end of life. Fire-fighting emissions are 0.5 % at production, 2% p.a. and 1% at disposal and Gas insulated switchgear loses 0.5% p.a. Foam blowing data is confidential. HFC emissions have increased from 2.55 tonnes of CO2 equivalent, in 1995, to 369.06 in 2000, the largest increases being in the areas of refrigeration, stationary and mobile air-conditioning and foam blowing. PFCs emissions have declined, from 440.05 (1995) to 266.44 tonnes (2000), as have SF6 emissions from 81.26 to 77.20 tonnes (Policy Makers Report, Annex 2), Sweden estimate that their business as usual emissions from refrigeration will be 736,000 tonnes in 2010

UK: ACRIB have performed a thorough review of the potential for improving leakage rate performance in the UK through a STEK type system. There is a fair degree of enthusiasm for such a system as long as it is reasonably flexible and paperwork is not too cumbersome. Current leakage rates are known to vary greatly depending on the type of installation and the attitudes of both the equipment owner and the maintenance contractor. Leakage rates as high as 20% (and as low as 3%) per annum are still being found in sectors such as supermarket refrigeration. There is thus recognition that STEK could achieve substantial savings.

b) Industry Response

Much work has already been performed under ECCP and in other studies to define the major sectoral issues relating to F gas usage. In this study we have therefore confined our research to assessing the awareness of schemes for regulation and the likely costs and benefits of these schemes as perceived by the refrigeration industry. We have contacted both users of refrigerant and their trade associations to ascertain what effect a STEK type system may have on their sector. These are reviewed in turn:

Representatives from industry in almost all 15 countries, including refrigerant contractors, equipment manufacturers and installers have been contacted to gauge their opinions on the potential implementation of either a STEK system or an extended 2037/2000 system EU wide. Their responses are briefly summarised below:

Promisingly, all respondents were aware of 2037/2000 and the majority were also aware of the STEK system and the likelihood that further regulation will be introduced to cover F gases.

Most respondents were in favour of more control on leakage rates, although some felt that a voluntary agreement would be best. Of those keen on regulation, all were strongly in favour of implementation but not necessarily as quickly as possible. The timescale required for “sensible” implementation varied from 2 to 5 years. Attitudes regarding the need for certification varied with some in favour but others regarding it as unnecessary. General comments on the structure of any scheme were as follows:

- The scheme should preferably build on what already exists in each country (although there was a degree of negativity about 2037/2000).
- A successful scheme would definitely be beneficial for industry, consumers, and the environment.
- The scheme must be simple and cost effective and generally STEK was not regarded as either simple or cost effective.
- It is important to maintain industry consultation (including end-users) and to keep industry informed at all stages of the regulation process to ensure that regulation is not overcomplicated or badly written.
- Training and qualifications must be sector specific and, as far as possible, not require re-training or re-testing of already qualified staff.

- Many felt that a scheme is “essential to remove the incompetent and uneducated operators”.
- Clearly costs were required to be “minimised”
- Several respondents wanted proper quality control of evaluators, rather than enforcement of legal requirements and a few saw an essential need for Government policing. Equally some regarded enforcement as unnecessary.

The Trade Association Response

AREA, (the Air conditioning and Refrigeration European Association) consists of 13 National associations, representing the European refrigeration installers / contractors / engineers. AREA thus represents the majority of the EU membership. AREA’s members represent more than 5,000 companies, a workforce of 73,000 and a turnover of approximately 20 billion € in the refrigeration and air conditioning sectors.

According to AREA[12], its members feel that the need for regulation of F gases in refrigeration is “self evident”. The members stated that STEK is a very useful first step towards defining these regulations. However, in its current format STEK, would be inappropriate for European-wide application as it is currently too prescriptive and inflexible and this would cause problems due to the many differences between the European countries. The AREA committee has gathered the opinions of its national member associations and has appointed a drafting team including the Netherlands, France, Germany and the UK. The result has been approved by the AREA General Assembly and is included in this report as an appendix. It provides guidelines for emission control of stationary refrigeration and air conditioning systems and heat pumps with a refrigerant fluid charge of more than 3 kg.

These guidelines give a general framework allowing the European Member States to implement them in a flexible manner. It gives a Europe wide harmonized compulsory management and control scheme to certify companies and personnel, again leaving flexibility to national implementation. The objective is to have the work performed and the cooling agents handled, from Portugal to Finland, from Greece to Belgium, only by trained professionals in order to obtain leakproof installations and to reduce to a maximum any loss of refrigerants.

Some AREA national members, like ANEFRYC (Spain), would like some kind of STEK-like system implementation, based on AREA guidelines. They are recommending STEK because of the improvement of quality, competence and safety of the sector, rather than to prevent greenhouse gas emissions, as there are other industrial sectors where greenhouse gas emissions can be prevented in a much more cost-effective way. VDKF (Germany) recommends also control of leakproofness and mandatory maintenance done by qualified and skilled personnel (based on AREA guidelines), but is in opposition to a STEK-like scheme because it would result in a breach of the fundamental movement of goods within the EU.[13]

12 AREA provided a written response which is reproduced in full in the Appendix

13 Note, this is the opinion of some members of AREA, however it is not obvious that STEK applied to the whole EU does restrict free movement of goods.

The overall conclusion is that for Europe wide implementation, STEK would need to be modified to work across Europe but that a modified system developed in consultation with AREA could be implemented relatively quickly and this would result in major emission reduction benefits. AREA is in favour of a stand-alone Directive on HFCs and is against any extension of EC 2037/2000 to deal with the HFC issues.

Sector Specific Issues:

In addition to the comments noted above, a few specific concerns relating to certain sub sectors of the refrigeration and air conditioning industry have been received. These are summarised below:

Domestic Refrigeration: Since domestic refrigeration is almost always hermetically sealed, the vast majority of leakage occurs during manufacture and at end of life. Current feedback suggests that STEK could easily be applied to these two processes and there should be significant leakage reduction achieved in these areas. However, the WEEE directive is likely to achieve many of the same aims in terms of end of life recovery and thus legislation in this sector is less urgently required.

Mobile Air Conditioning: Currently around 10-15% of charge is lost per year, (around 80-120g per year). The two sources of losses are: operation & maintenance and quality of parts. In addition, refrigerant will also be lost at “end of life” of the vehicle. However, this loss will be covered by the End of Life Vehicle directive and so legislation is not urgently required.

3. THE INTERVIEWS

These are provided separately on CD ROM. Please note the contents are confidential.

All Company details have been removed from the contractor interviews where appropriate.