

Contract title:

Analysis of health, socio-economic and environmental impacts in connection with possible amendments to Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)

Contract reference No: VC/2008/0692

Draft Final Report

June 2009

This publication is supported for under the European Community Programme for Employment and Social Solidarity (2007-2013). This programme is managed by the Directorate-General for Employment, social affairs and equal opportunities of the European Commission. It was established to financially support the implementation of the objectives of the European Union in the employment and social affairs area, as set out in the Social Agenda, and thereby contribute to the achievement of the Lisbon Strategy goals in these fields.

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June 2009

For the

EUROPEAN COMMISSION

Employment, Social Affairs and Equal Opportunities DG

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1. Background

The protection of workers' health against the negative direct and indirect impacts of electromagnetic fields is covered by the provisions of a European directive on minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (2004/40/EC). The EMF Directive came into force on 30 April 2004 when it was published in the Official Journal of the EU and originally Member States had until 30 April 2008 to implement the Directive. However, the final implementation date of the EMF Directive has been delayed until 30 April 2012. This allows the opportunity of a detailed assessment of the likely impact of the directive on the safety and health of all categories of worker, and on the environmental, economic, social, health or business impact on all stakeholders who may be affected by its implementation.

Directive 2004/40/EC of the European Parliament and of the Council of 29 April 2004 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) sets minimum requirements for the protection of workers from risks from exposure to electromagnetic fields. The EMF Directive allows Member States to set more strict limitations on exposure to electromagnetic fields than those contained in the EMF Directive.

The intention of the EMF Directive is to eliminate, or reduce to a minimum, risks arising from exposure to electromagnetic fields. These risks include those due to short-term adverse health effects in the human body caused by induced currents, energy absorption and contact currents. The EMF Directive does not address possible long-term effects such as carcinogenic effects.

As well as ensuring the health and safety of individual workers, the Directive is intended to make sure that all workers, in every country in the EU, are protected to at least a minimum level. This is to avoid possible distortions of competition that might occur if industries in some countries could reduce costs or increase productivity by exposing their workers to EMF risks.

The EMF Directive requires that the employer shall be in possession of an assessment of the risk arising from electromagnetic fields in the workplace and to take measures to eliminate or minimise any such risk. This means that the employer must make an EMF risk assessment the results of which must be recorded. If the risk assessment shows that no EMF risks exist in the workplace, then no further action is necessary, except to ensure that the risk assessment is kept up to date. If an EMF risk does exist then certain measures must be taken in order to avoid or reduce this risk e.g. by changing working practices or existing equipment by installing shielding or by limiting access. The EMF Directive also requires that the employer provides necessary information and training as well as any necessary health or medical surveillance for workers.

The EU-level implementation framework for the EMF Directive is based on the CENELEC standard EN 50499 which describes how a risk assessment should be made and introduces the idea that any workplace that is compliant with general public exposure levels or contains only equipment intended to be used by the public does not

require any further assessment. The standard also provides a framework for assessing indirect risks such as those to people with medical devices, from explosive atmospheres and from ferromagnetic objects in static magnetic fields.

EN 50499 is a technical standard, and in order to provide information more suitable for non-specialists, the European Commission has produced a Non-binding Guide to Best Practice for the Implementation of the EMF Directive. This Guide covers:

- The EMF Directive: Background & Introduction
- What is EMF?
- What does the EMF Directive protect against?
- Exposure limit values and action values
- EMF at Work
- Employer's responsibilities under the EMF Directive
- How to make a risk assessment for the EMF Directive
- What to do if there is an EMF risk in the workplace
- Workers at other workplaces
- Workers at particular risk

It also provides specific advice on situations in which measurements or other EMF assessments may be required, and when they are not.

The EMF Directive is intended to be transposed into national legislation in Member States before 30 April 2012 and some Member States have already done this. The EMF directive is given on the basis of the Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work. When the impact of the Directive 2004/40/EC is assessed, it should be taken into account that the Framework Directive 89/391/EEC is already in place and is implemented in the national legislation of every EU member state. However, in practise the level of implementation varies from country to country. If implemented completely the individual directives are affecting only very little to the practical health and safety management. All the important elements should be already in place based on the requirements of the Framework Directive.

As some examples the employer shall:

- Take the measures necessary for the safety and health protection of workers, including prevention of occupational risks and provision of information and training, as well as provision of the necessary organization and means;
- The employer shall be alert to the need to adjust these measures to take account of changing circumstances and aim to improve existing situations;
- Adapt the work to the individual, especially as regards the design of work places, the choice of work equipment and the choice of working and production methods;
- Develop a coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors related to the working environment;
- Evaluate the risks to the safety and health of workers.

Particularly sensitive risk groups must be protected against the dangers which specifically affect them. The management of risks shall be integrated into all the

activities of the undertaking and/or establishment and at all hierarchical levels (to have HSE-management system).

Since the demands for a risk assessment on EMF is in principle already laid out in the Framework Directive, the new EU directive on occupational exposure to electromagnetic fields should not be too much of a burden. What is new with the EMF directive is that one is getting a guideline with some numbers to meet, whereas in the Framework Directive the assessment had to be based on some international guidelines, like for instance those of ICNIRP or IEEE. However, it is not clear how many companies have actually performed such a risk assessment.

2. Objectives of the study

The objective of this project is to provide the European Commission with detailed analysis of the potential impact of a number of policy options related to implementation of Directive 2004/40/EC. The report of the project provides the information needed for the European Commission to initiate policy discussions regarding the possible future amendment of directive 2004/40/EC. It includes up-to-date information on the current situation in Member States and projected outcomes of the Commission's various possible policy options.

3. Description of EU policy options in impact assessment

The purpose of this study was to assess the impact of the various policy options as outlined below, including provision of up to date information. This is to enable the European Commission to initiate policy discussions regarding the possible future amendment of directive 2004/40/EC. For each of the policy options the information provided shall also assess and report on the consequences of not amending the Directive.

The policy options to be studied were:

Policy option A: No new legislative action. The European Union does not take any new initiative in this field. Directive 2004/40/EC and national regulatory provisions on the subject are considered to be appropriate and remain in force.

Policy option B: New binding legislative action. The European Union takes due account of the latest international recommendations and introduces new exposure limit values based on these recommendations.

Policy option C: New binding legislative action. The European Union takes due account of the latest international recommendations and introduces new exposure limit values based on these recommendations. However, conditional exemptions are foreseen for specific cases.

Policy option D: New, non binding, legislative action. The European Union takes due account of the latest international recommendations and introduces new recommendations for occupational exposure to electromagnetic fields. This may also entail: production of good practice guides, launch of regular information campaigns, setting up of appropriate training programmes, establishment of voluntary agreements at European or sectoral level between social partners.

Policy option E: No new legislative action. The European Union considers it inappropriate to take any legislative initiative in this field. Directive 2004/40/EC is repealed and national regulatory provisions on the subject are considered to be appropriate and remain in force.

Based on the feedback and comments of the stakeholders during the Workshop, it was decided to split the policy options C and D, given by the Commission, into two sub-policy options (C1, C2, D1 and D2).

The specified policy options considered are as follows:

Policy option A: Directive 2004/40/EC and national regulatory provisions on the subject remain in force. The existing exposure limits and the implementation framework of the EMF Directive are transposed into legislation in Member States. The EMF Directive provides the minimum health and safety requirements regarding the exposure of workers and each Member State can have stricter legislation. All employers are expected to be able to show compliance with the requirements of the Directive. To achieve compliance may require actions based on work place risk

assessment done according to CENELEC standards, as the Directive requires or with whatever national legislation is introduced.

Policy option B: The existing exposure limit values of the EMF Directive are replaced with new exposure limit values based on the latest international recommendations. The requirements may be based on the new guidelines for static magnetic fields and for the ELF range to be produced by ICNIRP during the year 2009 or possibly on IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz (C95.1) and IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz (C95.6). The Directive provides the minimum health and safety requirements regarding the exposure of workers and each member state can have stricter legislation. All employers are expected to be able to show compliance with the requirements of the Directive. To achieve compliance may require actions based on work place risk assessment.

Policy option C1: New exposure limit values based on the latest international recommendations are introduced. However, conditional exemptions are foreseen for specific cases which mean that some activities will be exempted from requirement for compliance with the exposure limit values of the Directive, but would still remain subject to a general EMF risk management requirement. Employers shall be able to show that no harm could come to workers from direct EMF health risks or from indirect risks, such as risks from ferromagnetic projectiles or interference with implanted medical devices. For this option the default would be that the exposure limit values of the EMF Directive are met unless a good safety assessment can be made explaining why and how safety is demonstrated without need to meet the exposure limit values.

Policy option C2: New exposure limit values based on the latest international recommendations are introduced. Some sectors/activities will be exempted entirely from all the requirements of the EMF Directive on the basis that their operation is not, and can never be, compatible with its requirements.

Policy option D1: The EMF Directive is replaced by non-binding occupational EMF exposure recommendations, based on the latest international recommendations. The form of these recommendations would be similar to the 1999 Council Recommendation on EMF exposures of the general public. This option may also entail production of good practice guides, launch of regular information campaigns, and setting up of appropriate training programmes.

Policy option D2: The EMF Directive is replaced by establishment of voluntary agreements at European or sectoral level between social partners. The European social partners have so far reach three “voluntary European framework agreements” implemented “in accordance with the procedures and practices specific to management and labour” in the respective Member State.

Policy option E: Directive 2004/40/EC is withdrawn and existing national regulatory provisions on the subject remain in force. Absence of national regulations in some Member States will allow unregulated occupational EMF exposures which may cause increased risk, lowering of equality, etc. For this option, it may be assumed that for example those countries which have already implemented the EMF Directive would not repeal their EMF legislation.

4. Methodology of the study

Information gathering and consultation were the keys to the project. The stakeholders who were consulted as an important part of the process to determine the impact of the policy options consisted of social partners and Member States representatives. This part of the project based on:

- collection of existing data
- a workshop
- circulation of questionnaires to social partners and Member States' Regulatory authorities
- interviews
- expert consultation
- visits to selected stakeholders to allow detailed assessment of possible impact on particular sectors/interests

In the analysis of the impact of the Commission's policy options, the following criteria were addressed specifically:

- health impact (workers and third parties)
- social impact (workers and third parties)
- economic impact (workers, employers and third parties)
- practicability, effectiveness and efficiency
- equality (gender & disability) impact
- business & organisational impact
- impact on science and on research

The impact assessment included using the expertise of the FICETTI grouping to make value judgments on

- the reliability of the information obtained
- the reliability of inference for policy impact

The inputs to the analysis were the information gathered from the workshop, the questionnaires and the visits as well as the knowledge and experience of the members of the FICETTI grouping. Matrices were developed to score the outcomes of each policy option.

The information-gathering and analysis were undertaken by multidisciplinary teams assembled specifically for those tasks and consisting of experts with experience matching the range of impacts to be investigated.

4.1. *Workshop*

The European Workshop on Stakeholders' Perspectives on Impacts of the EMF Directive was organized by the FICETTI Consortium in Ljubljana, Slovenia, 18-19 February 2009. The main purpose of the Workshop was to provide a platform for a discussion of issues related to the EMF Directive. It was held as a part of the EMF Impact -project that provides the European Commission with information on the impact of a number of policy options related to the possible future amendment of directive 2004/40/EC. The invited speakers from 28 different institutions and

stakeholders focused on the potential impact on each of five possible policy options for the future development of the EMF Directive (see Appendix 1). As representatives of an identified key stakeholder, key note speakers prepared oral presentation on their experiences and formal position in relation to five different policy options that were proposed by the European Commission. Of course, other perspectives beyond the responses to these questions were discussed as well, and these also provided input to the impact analysis. All presentations may be found on the web page www.inis.si/EMF2009.

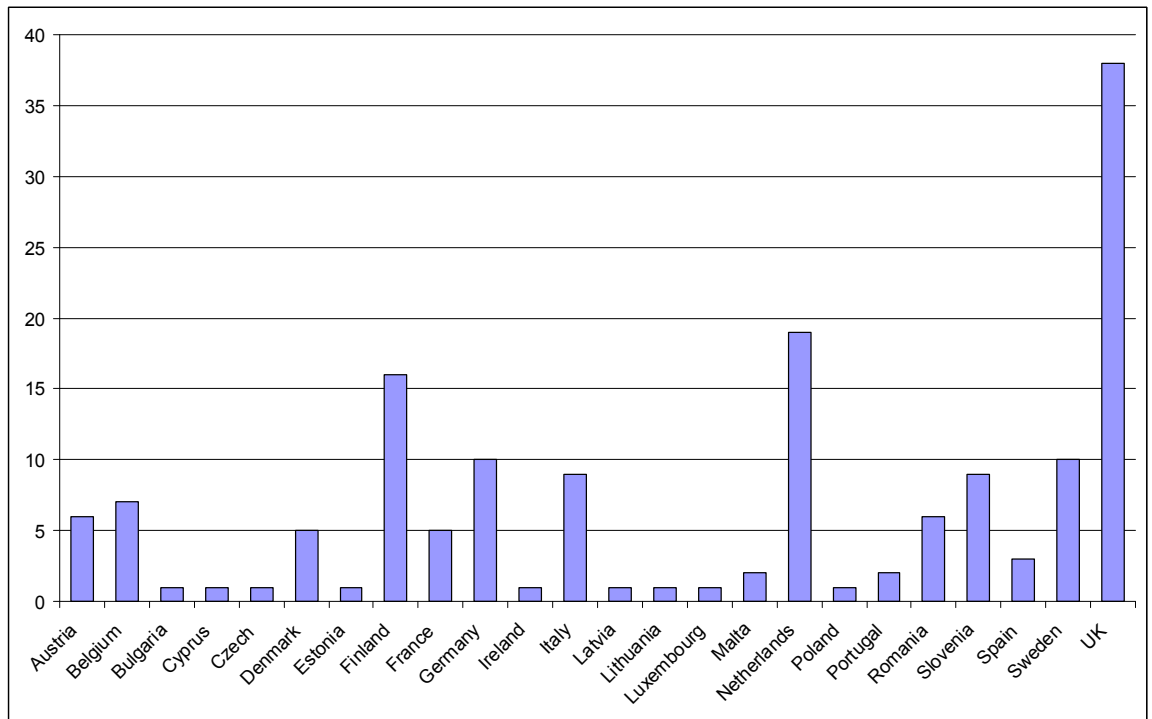
4.2. Questionnaire

A questionnaire was prepared in close collaboration with all FICETTI members during January and February 2009 (see Appendix 2). The contents of the questionnaire were finalised at the Consortium meeting organised in the context of the Workshop on 18.-20.2.2009 in Ljubljana. At the time it was decided to split the policy options C and D, given by the Commission, into two sub-policy options (C1, C2, D1 and D2) in the questionnaire based on the feedback and comments of the stakeholders during the Workshop.

After approval of the questionnaire by all members of the Consortium it was translated into French, German, Italian, Polish, Slovene and Spanish in the beginning of March in order to make it easier for stakeholders from different countries to fill in the questionnaire. The questionnaire was distributed on 13.3.2009 to targeted stakeholders including e.g. European and national social partners, representatives of different sized enterprises (large-scale, SME or micro-sized) and government/regulators. The number of identified individual stakeholders was 488 who were also requested to distribute the open link to the questionnaire to others acquainted with the EMF Directive and potentially interested in responding to the questionnaire. Also, the Focal Points network managed by the European Agency for Safety and Health at Work (EU-OSHA) was requested to distribute the questionnaire to the Member States' regulatory OSH authorities and other health and safety organizations. Furthermore, the Focal Points were asked to answer eight detailed questions concerning the current status of EMF legislation in their countries.

In total 166 stakeholders filled in the questionnaire. 90 of them have responded using a personalized link sent to them in the invitation e-mail whereas 76 persons have answered via open link to the questionnaire. Biggest group of respondents represented health care sector (61 persons), followed by metal industry (27 respondents), telecommunications or broadcast (15 respondents), electric energy production/distribution/transmission (13 respondents), and rail transportation (7 respondents). 55 respondents replied that they represent 'other sector', including e.g. universities, research centres, trade unions and military. Some respondents reported to represent two or more sectors.

156 respondents out of 166 reported their home country to be one of the EU member states. 6 persons reported to be 'Pan-European'. Individual responses from Georgia, Norway, Turkey and the USA were also obtained. The European respondents originated from the different EU member states as follows:



The used Digium internet survey method enabled the use of different kind of automatic reports (e.g. Appendix 3 and 4) in analysing the results of the questionnaire. In analysis process the responses were e.g. extracted by a home country or a sector of a respondent.

4.3. Case Studies

In order to look at a company level in a specific sector and try to quantify the impact of each policy option on that company, specific case studies were made using the knowledge and expertise of the FICETTI members. The case studies were made for the following sectors:

- Electricity distribution
- Electric welding
- Induction heating
- Surgical diathermy
- RF welding in a SME
- Broadcasting

Case studies were done by using mainly the current knowledge of a company/sector. In some cases a specific visit to a company was also made in order to gather further information. The assessment followed the implementation framework of EN50499/Non-binding Guide. It was found necessary to measure each impact as a change from the existing baseline for that country, i.e. the current EMF legislation and its requirements. Specific monetised impacts (in Euros) plus estimates of other (non-financial costs/benefits) for each policy options were estimated when possible.

The Case studies are presented in Appendix 15.

4.4. Visits

After the Workshop and receiving responses to the questionnaire, 17 visits to selected workplaces were made in total in all partner countries, i.e. in Finland, Italy, Poland, Slovenia, Sweden and the UK. The workplaces represented different sectors: broadcasting, health care sector, metal and mechanical industry, pharmaceutical industry and power distribution. 7 visits were made to large-scale enterprises (> 250 employees), 6 to SMEs (10 < employees < 250) and 4 to micro-sized enterprises (< 10 employees). Also, 4 visits were made to selected Pan-European stakeholders (social partners and government/regulators) representing e.g. SMEs and manufacturers of MRI equipment. The purpose of the visits was to gather more specific information on the implications of each of the policy options to be utilised in preparation of the case studies and in analysis of the results. The emphasis of the visits was on social, economic, health and organisational impact on particular sectors/interests. Also, equality issues (gender and disability) were evaluated. An interview template prepared for the purpose was used as a basis of the interviews (Appendix 17) where applicable.

5. Analysis and comparison of policy options

This section describes the way in which the information that was gathered from the Workshop, questionnaire, visits and case studies was analysed, and includes quantitative and qualitative estimates of the potential impact of each proposed policy option.

The strategy for analysis and comparison was taken from the Commission's Impact Assessment Guidelines (http://ec.europa.eu/governance/impact/docs_en.htm). There are four distinct steps to the analysis:

- Determining the baseline situation
- Analysing the number of workers and workplaces considered in the analyses
- Qualitative analysis of policy impacts
- Quantitative analysis of policy impacts

These are considered in turn below.

5.1. *Determining the baseline situation*

The inputs to this activity were the analysis information provided by the questionnaire, Workshop and visits, and the knowledge of the FICETTI Consortium. Its aim was to determine which of the policy options is equivalent to the current EU situation, and whether there are national differences.

Specific tasks within the activity include:

- Determine current legislative position with regard to EMF in EU, and in specific countries with EMF legislation beyond the Framework Directive
- Decide which Policy option most closely fits the existing position
- Report on baseline position; this task acts as an input to the quantitative and qualitative analyses.

5.1.1 **Current legislative position**

The information that was gathered on the current legislative position with regard to occupational exposures to EMF is in Appendix 5.

5.1.2 **Policy option most closely fitting the existing position**

It is clear from the tables in Appendix 5 that there is a diversity of EMF legislation in place in the EU member states. There are clear differences between states, and even between sectors – some states and some sectors have EMF policies in place which go beyond Option A; some have effectively none. There is also a difference between theory and practice in some countries.

It is possible to determine different groups, in terms of existing policy:

Option A-equivalent. No countries are yet in this position, but some sectors are (Telecommunications & broadcast, electricity generation and transmission).

Option B. Some countries, such as Poland, Germany, Estonia and Sweden (for high frequencies) are in this position.

Option C1. Some sectors (e.g. MRI, and the military) with a strong risk assessment culture but a problem with meeting the limits are more-or-less operating in accordance with Option C1. Most countries are also similar to C1 in principle, with a general requirement under the Framework Directive to do a risk assessment that includes EMF, but no hard adherence to ICNIRP limits even if they are recommended.

Option D. This is not in place in any countries.

Option E. In principle no country operates at the Option E level because the Framework Directive requires risk assessment that includes all workplace risks, but in practice in many countries and sectors (and particularly SMEs) this is the *de facto* situation. Usually this is because there is no awareness of the issue, and no active policing of EMF risk assessment as part of the overall risk assessment process needed under the Framework Directive.

5.1.3 Baseline position

It is clear that there is no single, consistent baseline position. There is the ideal situation following implementation of the Framework Directive – which in most countries results in a baseline close to Option C1 (and in a few to B) - and the *de facto* situation in some countries, and many sectors, of no real EMF component to risk assessment. On this basis, the approach taken for the analyses in Sections 5.2 and 5.3 is to consider the impact of the seven Policy Options from two different baselines – one in which the Framework Directive has been fully implemented and one in which it has not been.

5.2 ***The number of workers and workplaces considered in the analyses***

A task group was set up to try to determine the numbers of workers and workplaces in each employment sector considered in subsequent analyses. The data produced in this task were used in task 5.3 as weighting factors for the questionnaire results, and as inputs to the quantitative analyses in task 5.4.

The data sources used were the Workshop presentations, research by Consortium members and the UK HSE's 2003 EMF Directive Impact Assessment available at <http://www.hse.gov.uk/radiation/nonionising/emfria.pdf>.

The estimated numbers of workers and workplaces for each sector considered are listed in Appendix 6.

5.3 Qualitative analysis of policy impacts

5.3.1 Analysis and reporting of information from questionnaire

Appendix 7 describes how the responses for each question were extracted from the questionnaire, and provides the responses broken down by sector.

Table 5.1 shows the overall responses to the questionnaire, without any sector-specific analyses or weighting.

Table 5.1 Non sector-normalised, unweighted overall questionnaire responses (%)

	Economic	Health	Social	Total
Option A	-17	4	0	-13
Option B	-12	6	2	-4
Option C1	-8	5	4	2
Option C2	-8	0	0	-8
Option D1	-4	0	1	-3
Option D2	-7	-4	-3	-14
Option E	-1	-5	-3	-9

One issue with a questionnaire is that the overall pooled answers can be skewed by over-representation by one sector or interest group. To address this issue, each sector-specific dataset of questionnaire scores was normalised by the maximum possible score for the whole questionnaire to express it as a percentage, and then the sector-derived percentages were combined without any weighting. The results are shown in table 5.2 below, in which values below -25 are shown in red, those between 0 and -25 % in pink and those between 0 and 25% in green:

Table 5.2 Unweighted sector-normalised questionnaire responses (%)

	Economic	Health	Social	Total
Option A	-16	5	1	-10
Option B	-11	7	4	0
Option C1	-8	6	4	3
Option C2	-9	1	1	-7
Option D1	-6	-1	-1	-7
Option D2	-7	-4	-4	-15
Option E	-2	-5	-4	-11

This approach effectively weights all sectors equally, irrespective of the numbers of workers in each, or the number of workplaces that might need to be assessed. In task 5.2 the numbers of workers in each sector and the number of assessments/workplaces that might be needed for each sector were estimated. Extracting these data for the sectors considers gives:

Table 5.3 Estimated numbers of workers and workplaces/assessments for each sector considered

Sector	Workers	Workplaces/assessments
Electric energy	200000	3000
Health care	111000	10500
Metal industry	1019000	162140
Telecoms & broadcast	39500	11000
Rail	120000	500
Other	50000	25000
Total	1539500	212140

If the questionnaire responses shown in Table 5.2 are weighted by worker numbers in each sector, or by the number of workplaces/assessments needed in each sector, then the distribution of answers becomes:

Table 5.4 Sector-normalised questionnaire responses (%) weighted by worker numbers

	Economic	Health	Social	Total
Option A	-24	2	-2	-24
Option B	-15	8	4	-3
Option C1	-12	7	5	0
Option C2	-14	2	1	-11
Option D1	-9	0	1	-8
Option D2	-14	-4	-5	-24
Option E	-2	-4	-4	-10

Table 5.5 Sector-normalised questionnaire responses (%) weighted by workplace/assessment numbers

	Economic	Health	Social	Total
Option A	-25	2	-2	-25
Option B	-15	8	4	-2
Option C1	-12	7	5	0
Option C2	-14	1	1	-13
Option D1	-10	1	1	-8
Option D2	-16	-4	-5	-26
Option E	-3	-4	-3	-10

The exact numbers in these tables are very sensitive to assumptions made about the number of workers and workplaces/assessments in each sector, and of course to the extent to which the questionnaire responses may be considered representative. It is perhaps reassuring to note that the patterns of response (as indicated by colour) do not change very significantly between the different weighting approaches, particularly with respect to the total highest-scoring option. This is consistently Option C1, followed by B and then D1. A and D2 seem to be the least popular and C2 and E the next least-popular. C1 is the only option to consistently attract overall-positive totals.

In order of total score, the options can be listed as:

1	C1
2	B
3	D1
4	C2 and E
5	A and D2

Although the overall scores (weighted and unweighted) pooled across all sectors show a general preference for Option C1, it is of interest to consider the scoring on a sector-by-sector basis. The key features of the sectoral analyses are:

- The “other” and telecommunications sectors were strongly in favour of Options A-C1, with B being the favoured option, and strongly against Options C2-E
- The healthcare sector preferred Options C1, C2 and D1
- Only the electrical sector actually preferred C1 overall
- The rail sector preferred Option B
- The metal working sector disliked all options

One interesting aspect of many of the sectoral analyses is the effect of the economic questions. It is clear that in many cases Option E has been scored as if it entailed no EMF assessment requirements at all, rather than the baseline position of compliance with the Framework Directive.

It was noted in many of the open question responses to the questionnaire that respondents found it difficult to reliably estimate the impact of Option B in the absence of information on what new limits might apply.

5.3.2 Analysis of information from visits

After the Workshop and the questionnaire had been completed, a series of visits to stakeholders were made by the project team. The Consortium was aware that microenterprises were under-represented in the questionnaire returns, so these organisations were especially targeted for visits as were other businesses who had answered the questionnaire in such a way that there were indications of important issues to explore.

21 visits were made, to organisations in Belgium, Finland, Italy, Poland, Slovenia, Sweden and the UK. 10 of these organisations were SMEs or microenterprises and one was an EU-level SME trade organisation. Key information, opinions or observations arising from the visits that had not been obtained previously are summarised in Appendix 8.

The main conclusions from these visits were:

- There is a great deal of difference between the considerations given to EMF issues in different countries. Most enterprises in Poland and Slovenia were aware of the issues and many (even microenterprises) had undertaken or considered

assessments and had strategies in place for addressing the issues of pregnant workers and users of active implanted medical devices. In contrast, in the UK there was close to zero awareness of EMF as a workplace issue amongst SMEs and microenterprises undertaking welding. This reflects the different baseline situations discussed in Section 5.1.

- There was, in most organisations visited, recognition of the benefits of an EU-level legislative basis for workplace EMF protection.
- There was concern about potential economic impacts, especially of Option A, on SMEs.
- There is a desire to see more sector-specific EMF advice developed, no matter which Policy option is selected.

5.3.3 Qualitative analysis based on likely policy option outcomes

This action identifies the possible specific impacts of each policy option and attempts to determine (qualitatively) costs, benefits and potential unintended consequences. The inputs were the open question answers from the questionnaire, workshop, visit reports, the knowledge of the Consortium plus the impacts already identified as the basis of the questionnaire closed questions.

Possible impacts and consequences were identified at the level of: worker; company; sector; nation; EU. These are:

Worker's level impacts and consequences:

- Possibility of increased health risk
- Possibility of decreased health risk
- Knowledge
- Awareness
- Reassurance about health, safety & wellbeing
- Social safety
- Access to workplace for sensitive workers

Company level impacts and consequences:

- Costs
- Administrative burden
- Absenteeism
- Productivity
- Knowledge
- Inequality between enterprises
- Competitiveness
- Demonstrating safe workplace
- Tools for necessary risk assessment & management
- Reassurance of public that limits are met

Sectoral level impacts and consequences:

- Sectoral agreements

National level impacts and consequences:

- Research & development

- New technologies & innovation
- Cost of enforcement
- Burden on regulators
- Political acceptability

EU level impacts and consequences:

- Ability of social partners to be involved
- Research & development
- New technologies & innovation
- Political acceptability
- Impacts on society

For each of the impacts and consequences at each level, the direction (positive or negative), intensity (how important it may be) and likelihood were estimated and an impact matrix was developed. For example, the part of the impact matrix for the impact of Policy option A at worker level is:

	Policy option A			
	Direction	Intensity	Likelihood	Resultant
	-1	3	3	-9
	1	3	3	9
	1	1	3	3
	1	2	3	6
	1	3	3	9
	1	1	2	2
	1	1	2	2
	total			22

The full impact matrix is given in Appendix 9.

For each policy option, a generic causal model based on the impact matrix was developed. Causal models are a way of seeing the interrelationships of the possible policy outcomes, using the impact matrix values to define the importance and direction (positive or negative) of the impacts.

The precise numbers in the impact matrix are not particularly important – they are used only as an input to the development of the Causal Models.

The generic causal models for each policy option are shown in Appendix 10. The model for Policy option A is shown below as an example:

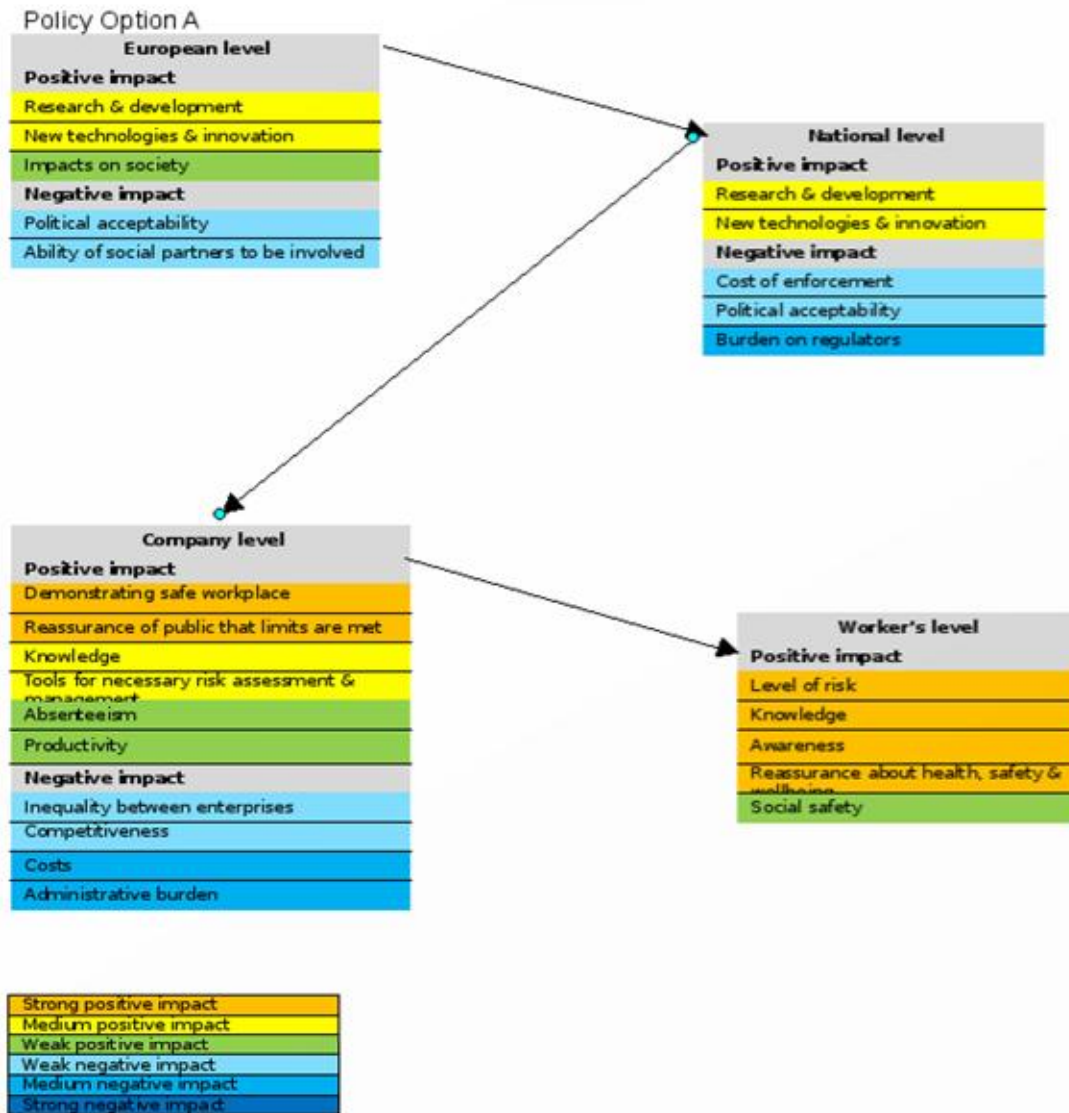


Figure 5.1 The causal model for Policy Option A

5.3.4 Specific qualitative impacts

5.3.4.1 Social impacts

Four main aspects of social impact were identified from the questionnaire open questions, Workshop, visits and the consortium's own knowledge:

- Equality: gender/disability access to workplace
- Social safety (employment)
- Lack of access to leading-edge healthcare
- Public concern about EMF

Equality: gender/disability access to workplace

The question of gender-related workplace access as related to occupational EMF exposure is a difficult one to analyse. The specific issue is the way that pregnant workers and women of child-bearing age are treated; pregnant workers might be considered “sensitive workers” for two reasons: one is that pregnant women, especially in the final trimester, may have an impaired thermoregulatory ability, making them potentially more sensitive to the thermal effects of exposure to radiofrequencies. The other issue is the status of the fetus; there is a question as to whether it should be exposed at the occupational or general-public EMF limits, and this may have an implication for the exposure of the mother - and by extension her ability to undertake certain work.

The EMF Directive as it is currently worded gives little guidance on this matter, and it is likely something that would be addressed (if at all) in the details of national implementation. On this basis it is not possible to determine what, if any, differences there might be between the access of women to the workplace, and their job security, between the seven different policy options. It is possible that Option E would be slightly less protective in this respect as (at least in the interpretation that requires no real consideration of EMF risk in the workplace) although of course equality legislation in many countries would prevent overt discrimination.

There is a definite difference between the seven options as regards access to the workplace of people with medical implants. The default situation (Option E, C2 and possibly D2) is that in the absence of specific information to the contrary, workers with medical implants are excluded from workplaces with high levels of EMF. The EMF Directive (Options A, B and C1) has a specific requirement that specific assessments are done to determine the extent to which the access of such people to high-EMF workplaces should be controlled. CENELEC has produced assessment standards specifically to facilitate this.

Social safety (employment)

The issue of social safety is primarily a matter of whether the existence of businesses (and the jobs of workers) might be threatened by the requirements of any of the options.

The answers to open questions in the questionnaire, and some of the Workshop presentations, indicated that this might be a particular issue for microenterprises. The implementation framework that has been developed for the EMF Directive is intended specifically to minimise the impact on SMEs, but concerns remain that there is not sufficient information for these companies to be able to declare with confidence that they do not have an EMF issue, and that many of them will opt to use health and safety consultants at significant cost.

This aspect is explored further in Section 5.3.4.2.

Lack of access of patients to leading-edge healthcare

This is a particular issue for any impact on MRI. It has been estimated by the HPA in the UK that perhaps 3.5% of current MRI procedures would be impossible under Option A, but that the biggest impact on leading-edge healthcare might be the lack of development of interventional MRI.

Public concern about EMF

The issue was raised at the Workshop of undermining existing guidelines used for general public exposures to fields from power lines and telecoms. In many countries, compliance with ICNIRP guidelines (possibly with an extra safety factor) is used to show that there is no public hazard from EM fields. If there were to be an explicit rejection of the validity of the ICNIRP guidelines then it is feared that public confidence in EMF safety could be adversely affected.

5.3.4.2 Specific impacts on SMEs

The information in this section comes from the Workshop, the questionnaire open questions, and visits.

There is a clear need for SMEs to be able to address only real problems. The current implementation framework for the EMF Directive allows that, but this is not explicit in the Directive itself and, particularly, the “white list” from EN54099 is not included.

There is a severe information deficit for SMEs, and there is a wish for simplified information at the EU level – small states may be unable to provide the necessary details in their national implementations.

There is a wish for sector-specific guides, whichever Policy option might be implemented. A simple (maybe three-page) checklist for each sector should be developed, and this should be a Commission priority. Equipment labelling and better manufacturer information would be helpful; although this would not solve the problems of legacy equipment that might be addressed *via* a transition phase for implementation.

It is felt that SMEs would find the advice on implanted medical devices difficult to follow in practice.

The Consortium has compiled a summary of experiences of peaking to small businesses about EMF exposure and their obligations and performing EMF exposure surveys in SMEs. This summary is to be found in Appendix 11. It concludes that:

- Most employers believed that the principal of the Directive was well meant
- A minority were against the Directive
- Most found the costs for risk assessment and measurement surveys to be high but would pay to allay fears of their employees

5.3.4.3 Impacts on Health

There are four main aspects to the question of health impact:

- Avoidance of overexposures
- Avoidance of worker concern
- Protection of the employer
- Adverse health consequences

Avoidance of overexposures

Documented overexposures to EMF are rare, but not unknown. The best-recorded cases have occurred in the broadcast industry, and there are some data on the work

and financial impacts of such events. It is estimated (see attached the analysis in Appendix 12) that the immediate cost per case is around 8 000 euros, but that if the event results in long-term sick leave the cost to the employer could be tens of thousands of euros.

Avoidance of worker concern

This is one of the main drivers for employers to consider and quantify any EMF risk in the workplace. In the absence of an EMF Directive and its implementation framework, many employers engage consultants to make EMF assessments even where these are not needed; the implementation framework of EN50499 and the Guide to the Directive have been developed to try to minimise this and to shift the focus to the few occupational EMF exposure situations that warrant detailed investigation. The advantages of Options A to C (and possibly D1) are that an employer can easily and with maximal cost-effectiveness show that there is no workplace EMF risk.

Protection of the employer

Following from the idea of avoiding worker concern is that of protection for the employer. It was made clear at the Workshop and in answers to the questionnaire that many employers favour clear limits that they can show compliance with, rather than a general safety requirement or a sector-specific voluntary agreement. Clear limits provided by an external (and perceived as independent) authority are seen as a way to be seen to fulfil employers' responsibilities in a transparent manner.

One case study (see Appendix 13) that the FICETTI consortium has developed is an analysis of the situation of an employer facing legal action over noise. The exposure in question occurred before the implementation of the Noise Directive, and whilst it is likely that had an assessment be performed at the time it would have indicted compliance with the requirements of that Directive, this was not done. The employer estimates that costs to defend the business may exceed 10 000 euros. He has stated that his preferred option for the future would be to

'ensure that if there was any future questioning of his duties as an employer or any accusation of injury sustained he could present his risk assessment to show compliance and to protect the viability of the business'.

Adverse health consequences

It may seem counter-intuitive, but it is possible that more stringent EMF exposure restrictions could actually lead to an increase in risk of adverse health consequences. An example of this would be the MRI situation, where Option A might lead to a transfer from MRI to computed tomography (CT) x-ray scans. The FICETTI consortium asked the UK's Health Protection Agency to consider the potential shift from MRI to CT that Option A might engender. Their calculations indicate that the increased collective ionising radiation dose for workers in England and Wales might be 3-5 man Sv per year. This could be scaled by a factor of perhaps 10 for the whole EU. A financial cost of 50k euros per man Sv is often used in ionising radiation optimisation, giving a total annual financial cost of perhaps 2.5M euros.

The Alliance for MRI has provided a similar calculation for increased patient exposure to ionising radiation, and the corresponding figure is approximately 175M euros. They suggest a figure five times larger for lost "opportunity cost" from an

inability to employ interventional MRI in the future, but this figure is very speculative indeed.

5.3.4.4 Impacts on competition in the internal market

It is considered that this is not a relevant issue for possible EMF Directive Policy Options.

5.3.4.5 Effects on competitiveness of European businesses compared to those outside the EU.

Some questionnaire respondents have commented on this; there is likely to be an impact, especially with Option A, although its effect for other options might be quite small if the existing baseline were taken to be a full implementation of the requirements of the Framework Directive.

5.3.4.6 Environmental impact

It is considered that this is not a relevant issue for possible EMF Directive Policy Options.

5.4 Quantitative impact analyses

5.4.1 Assessing administrative burdens

This has been done for each Policy option using the EU ‘Standard Cost Model’ and the ‘Administrative Burdens Calculator’ available on the DG ENTR website, using the assumptions that there are 20 million workplaces in the EU, that 1.5% of them will need a risk assessment beyond a simple determination that they are automatically compliant with the requirements of the EMF Directive and that the existing implementation framework for the Directive is properly applied to Policy options A-C.

The other inputs to the analysis are the number of workers and workplaces/assessments needed for each sector (from task 5.2) and the experience of the Consortium in the amount of time likely to be needed for each of the administrative tasks identified.

The administrative costs will be very similar for Options A-C; even sector-specific exemptions will not change the costs in a predictable way unless multiple large sectors are exempted. For Options D1, D2 and E we have tried to estimate how costs might change if the implementation framework of the Guide and the EMF Directive is removed and replaced with a non-binding recommendation, sector-specific voluntary agreements or with reliance only on the Framework Directive (option E). Table 5.6 shows the estimated administrative costs for each Policy option; it is notable that whilst Option D2 is the lowest cost option, the removal of the detailed implementation framework that Option D1 and E imply would lead to an *increased* administrative burden if the requirements of the Framework Directive were to be met.

Table 5.6 Estimated EU-level administrative costs for each Policy Option

Policy option	Costs (M euro)
A	44
B	44
C1	44
C2	44
D1	60
D2	39
E	68

Taken across the whole EU, these estimated costs are quite modest.

The detailed spreadsheet calculations used to estimate these costs are given in Appendix 14.

5.4.2 Specific costs of assessment for each option

This task involved the calculation of the costs of following the assessments procedures needed for each Policy option in each sector. As discussed in Section 5.1, it was decided to base the analysis on two possible baseline scenarios: that the Framework Directive is fully implemented, and that it is not and that Option E allows some sectors to undertake no EMF risk assessment at all (the *de facto* case in some countries/sectors).

The estimated costs are derived from the series of case studies investigating the costs of implementation in each sector. These case studies can be found in Appendix 15. Other inputs to the analysis include the numbers of assessments that are needed in each sector.

The full analysis can be found in Appendix 16.

The totals are shown in Table 5.7. The “Framework Directive implemented” case is the situation in which the existing legislative requirements for EMF to be considered as part of an overall workplace risk assessment are met. The “Framework Directive not implemented” case is the situation that exists in some countries and sectors, where EMF as a workplace issue is not recognised at all and risk assessments do not consider it.

Table 5.7 Total assessment costs for each policy option

Policy Option	Assessment cost (M euro) at EU level	
	Framework Directive implemented	Framework Directive not implemented
A	762	762
B	1123	1123
C1	299	299
C2	299	4
D1	299	299
D2	299	299
E	299	4

Policy Option B is the most expensive because it includes the requirement for broadcast and telecommunications companies to replace their personal dosimeters if the action values of the Directive are changed from the existing ICNIRP values. It is not clear how big this impact may be, and it is also quite likely (based on discussion at the Workshop) that Telecoms companies would continue to use existing limits, at least in the short term. This is because any increase in limits might be unacceptable to workers given that the companies are quite able to work to the existing ones. It may be that the true costs for Option B would be nearer those of Option A, or possibly C1.

Policy Options C2 and E in the zero-basis case are costed on the basis that no sector has to make any assessment; the residual costs are those of the telecommunications and power generation/transmission sectors; these sectors would continue to work to ICNIRP restrictions.

Although it appears that the Framework Directive not implemented case is cheaper than the Framework Directive implemented case, this is because the *Framework Directive implemented* case includes the cost of work already done to meet necessary legal requirements. In fact it might be argued that these are monies already invested in work that has to be done, and that the future costs are actually the differences between the two cases. On this basis, Options C2 and E have the highest liabilities.

6. Summary

6.1 Baseline position

It is clear that there is no single, consistent baseline position. There is the ideal situation following implementation of the Framework Directive – which in most countries results in a baseline close to Option C1 (and in a few to B) - and the *de facto* situation in some countries, and many sectors, of no real EMF component to risk assessment. On this basis, the approach taken for the analyses in Sections 5.2 and 5.3 is to consider the impact of the seven Policy options from two different baselines – one in which the Framework Directive has been fully implemented and one in which it has not been.

6.2 Analysis and reporting of information from questionnaire

In order of total score on the basis of the questionnaires, the options can be listed as:

1	C1
2	B
3	D1
4	C2 and E
5	A and D2

The key features of the sectoral analyses are:

- The “other” and telecommunications sectors were strongly in favour of Options A-C1, with B being the favoured option, and strongly against Options C2-E
- The healthcare sector preferred Options C1, C2 and D1
- Only the electrical sector actually preferred C1 overall
- The rail sector preferred Option B
- The metal working sector disliked all options

One interesting aspect of many of the sectoral analyses is the effect of the economic questions. It is clear that in many cases Option E has been scored as if it entailed no EMF assessment requirements at all, rather than the baseline position of compliance with the Framework Directive.

It was noted in many of the open question responses to the questionnaires that respondents found it difficult to reliably estimate the impact of Option B in the absence of information on what new limits might apply.

6.3 Analysis of information from visits

- There is a great deal of difference between the considerations given to EMF issues in different countries. Most enterprises in Poland and Slovenia were aware of the issues and many (even microenterprises) had undertaken or considered assessments and had strategies in place for addressing the issues of

pregnant workers and users of active implanted medical devices. In contrast, in the UK there was close to zero awareness of EMF as a workplace issue amongst SMEs and microenterprises undertaking welding. This reflects the different baseline situations discussed in Section 5.1.

- There was, in most organisations visited, recognition of the benefits of an EU-level legislative basis for workplace EMF protection.
- There was concern about potential economic impacts, especially of Option A, on SMEs.
- There is a desire to see more sector-specific EMF advice developed, no matter which Policy option is selected.

6.4 Specific qualitative impacts

6.4.1 Social impacts

It is not possible to determine what, if any, differences there might be between the access of women to the workplace, and their job security, between the seven different policy options. It is possible that Option E would be slightly less protective in this respect as (at least in the interpretation that requires no real consideration of EMF risk in the workplace) although of course equality legislation in many countries would prevent overt discrimination.

There is a definite difference between the seven options as regards access to the workplace of people with medical implants. The default situation (Option E, C2 and possibly D2) is that in the absence of specific information to the contrary, workers with medical implants are excluded from workplaces with high levels of EMF. The EMF Directive (Options A, B and C1) has a specific requirement that specific assessments are done to determine the extent to which the access of such people to high-EMF workplaces should be controlled.

It has been estimated by the HPA in the UK that perhaps 3.5% of current MRI procedures would be impossible under Option A, but that the biggest impact on leading-edge healthcare might be the lack of development of interventional MRI.

The issue of undermining existing guidelines used for general public exposures to fields from power lines and telecoms was raised at the workshop. In many countries, compliance with ICNIRP guidelines (possibly with an extra safety factor) is used to show that there is no public hazard from EM fields. If there were to be an explicit rejection of the validity of the ICNIRP guidelines then it is feared that public confidence in EMF safety could be adversely affected.

6.4.2 Specific impacts on SMEs

There is a clear need for SMEs to be able to address only real problems. The current implementation framework for the EMF Directive allows that, but this is not explicit in the Directive itself and, particularly, the “white list” from EN54099 is not included.

There is a severe information deficit for SMEs, and there is a wish for simplified information at the EU level – small states may be unable to provide the necessary details in their national implementations.

There is a wish for sector-specific guides, whichever Policy option might be implemented. A simple (maybe three-page) checklist for each sector should be developed, and this should be a Commission priority. Equipment labelling and better manufacturer information would be helpful; although this would not solve the problems of legacy equipment that might be addressed via a transition phase for implementation.

It is felt that SMEs would find the advice on implanted medical devices difficult to follow in practice.

6.4.3 Adverse health consequences

It may seem counter-intuitive, but it is possible that more stringent EMF exposure restrictions could actually lead to an increase in risk of adverse health consequences in some situations. An example of this would be the MRI situation, where Option A might lead to a transfer from MRI to computed tomography (CT) x-ray scans.

6.5 Quantitative impact analyses

Using the EU ‘Standard Cost Model’ and the ‘Administrative Burdens Calculator’ available on the DG ENTR website, the administrative costs of the Policy Options have been calculated as between 39 and 68 million euros. It is notable that whilst Option D2 is the lowest cost option, the removal of the detailed implementation framework that Option D1 and E imply would lead to an increased administrative burden if the requirements of the Framework Directive were to be met.

6.6 Specific costs of assessment for each option

The estimated costs are derived from the series of case studies investigating the costs of implementation in each sector. The Policy option B is the most expensive because it includes the requirement for broadcast and telecommunications companies to replace their personal dosimeters if the action values of the Directive are changed from the existing ICNIRP values. It is not clear how big this impact may be, and it is also quite likely (based on discussion at the Workshop) that Telecoms companies would continue to use existing limits, at least in the short term. This is because any increase in limits might be unacceptable to workers given that the companies are quite able to work to the existing ones. It may be that the true costs for Option B would be nearer those of Option A, or possibly C1.

Although it appears that the Framework Directive not implemented case is cheaper than the Framework Directive implemented case, this is because the *Framework Directive implemented* case includes the cost of work already done to meet necessary legal requirements. In fact it might be argued that these are monies already invested in work that has to be done, and that the future costs are actually the differences between the two cases. On this basis, Options C2 and E have the highest liabilities.

7. Concluding remarks

The potential impacts of seven policy options for the EMF Directive have been assessed. This assessment has taken account of the views of stakeholders and also the expertise of the FICETTI consortium.

- Option A is generally considered to have disproportionate economic costs, especially for SMEs
- Option B has been difficult to assess in the absence of new exposure guidelines from ICNIRP; it has rather high economic consequences but scores well on social and health impacts
- Option C1 is the only option to score consistently positively in the stakeholder-based analysis.
- Options D and E score badly on health and social impact grounds. Option E especially is unpopular with stakeholders.

If the baseline situation is that EMF risk is already considered as required by the Framework Directive, then the costs of each Policy option are broadly similar, with Option A (and possibly B) being the most expensive.