WORKING FOR A HEALTHY FUTURE

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Health, socio-economic and environmental aspects of possible amendments to the EU Directive on the protection of workers from the risks related to exposure to carcinogens and mutagens at work

Mineral Oils as Used Engine Oils

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SUMMARY

Untreated or mildly treated mineral oils are classified by the International Agency for Research on Cancer as carcinogenic to humans (IARC category 1). Mineral oils as used engine oils are not specifically classified, although there is evidence that they, like untreated oils, can cause non-melanoma skin cancer, probably as a result of contamination with PAHs. Used engine oils are not classified in Europe under the classification and labelling regulations and so they are not currently within the scope of the Directive.

The main potential hazardous exposure arises from skin contact and so it is inappropriate to consider setting an inhalation Occupational Exposure Limit. A biological monitoring limit value is also considered impractical and inappropriate. We therefore consider that the best approach to control the risk from used engine oils would be through the application of best practice in preventative work practices and personal protective equipment.

Non-melanoma skin cancer is the commonest malignancy in Europe with perhaps half a million cases occurring each year, although reliable statistics are not available. Incidence is increasing, partly because of the ageing population and partly because of changing exposure to sunlight, which is the main environmental cause. Treatment is relatively straightforward and there is a very high survival rate (about 99%). The health costs are therefore lower than for other types of cancer.

We judge that exposure is most likely amongst people employed in motor vehicle maintenance and recycling of non-metal scrap, although we do not have reliable information about the prevalence of exposure. It is estimated that at most there could be 1 million people exposed to used engine oil in the EU. There is no information about the magnitude of exposure or about how this may have changed in recent years.

The predicted number of deaths in 2010 from past occupational exposure to used engine oil is 7, which is based on about 916 incident cases. There are judged to be an associated 93 DALYs and 71 YLLs. Over the period until 2060 the annual incidence is expected to rise to about 3,554 cases and 36 deaths as a consequence of demographic changes and increased employment in the relevant industry sectors. DALYs and YLLs increase correspondingly. These data are likely to overestimate the health impact because we have had to used data on employment within the relevant sectors rather than exposure to used engine oil and because we have been unable to take account of improvements in controls in recent years.

The health costs over the next 60 years, if no action is taken, are estimated to be between about €445m and €2,815m. Possible policy interventions focus on ensuring best practice techniques are used in handling used engine oil. In our view the appropriate changes to the Directive would need to focus on suitable protective clothing and protective gloves, training and supervision to ensure exposure was minimised, encouragement of good personal hygiene and appropriate health surveillance to ensure early detection of NMSC. In our analysis we assumed that between 10% and 40% of employees are currently being exposed to used engine oil in a way that does not conform with best practice; involving between about 20,000 and 78,000 enterprises in Europe. The total estimated cost of introducing best practice over the next 60 years is judged to be between about €46m and €920m.

It are not expected that there will be any important social, macro-economic or environmental impacts.

We consider that it would be prudent to undertake measurements of dermal exposure to used engine oil to assess the extent of exposure, both in situations that are poorly controlled and perhaps representative of historic exposure, and in situations where good practice is in place. These data would help inform any regulatory action.

1 PROBLEM DEFINITION

1.1 OUTLINE OF THE INVESTIGATION

Mineral oils as used engine oils were assessed by the International Agency for Research on Cancer (IARC) in 1984 as part of an overall assessment of the carcinogenicity of mineral oils. At that meeting they concluded that there was sufficient evidence from studies in humans that miner oils containing various additives and impurities used in several occupations were carcinogenic in humans. The data from animal studies was more equivocal. The final evaluation does not explicitly mention “Mineral oils as used engine oil”, but concludes that “Mineral oils, untreated or mildly treated” are carcinogenic to humans (IARC category 1)[1]. These were again reviewed by IARC in 2009 where the categorization was retained in relation to skin cancer (Baan *et al*, 2009).

Used engine oils are not categorised as a carcinogen in the EU under the classification and labelling legislation. They are therefore not currently regulated as a carcinogen throughout the EU.

In this assessment we consider the impacts of introducing mineral oils as used engine oils within the EU Carcinogens and Mutagens Directive. The key objectives of the present study are to identify the technical feasibility and the socioeconomic, health and environmental impacts of introducing a regulatory intervention for “Mineral Oils as Used Engine Oils”.

1.2 OELS/EXPOSURE CONTROL

The Institut für Arbeitsschutz der Deutschen Gestzlichen Unfallversicherung (IFA) maintains a database of occupational exposure limits in EU member states.[2] No exposure limits for used engine oils are recorded in the database.

In conducting the assessment we have assumed that the prime route of exposure is via the skin and that the main carcinogenic hazard present in the used engine oils are polycyclic aromatic hydrocarbons (PAHs).

1.3 DESCRIPTION OF DIFFERENT USES

Engine oils (also known as motor oils or crankcase oils) are used in internal combustion engines to lubricate and cool the moving parts within the engine. They are used primarily in automobile and motorcycle engines, diesel rail engines, marine engines, diesel aeroengines, but are also used in the engines in portable machinery including chain saws and lawn mowers.

New engine oils are blends of hydrocarbons (including paraffins, olefins, and acetylene hydrocarbons and their derivatives) and lubricating additives. The chemical composition of new engine oils varies depending on the needs of different engines and operating conditions. Advances in petroleum refining processes have reduced the levels of impurities such as polycyclic aromatic hydrocarbons (PAHs) in new engine oils and currently new engine oils are not considered to represent a cancer risk (Tolbert, 1997).

[1] Available at: http://monographs.iarc.fr/ENG/Classification/ClassificationsAlphaOrder.pdf
[2] Available at: http://www.dguv.de/bgia/en/gestis/limit_values/index.jsp

During use, the composition of the oil changes due to high temperatures and mechanical strains. Nitration, polymer cracking, oxidation and decomposition of organometallic compounds within the oil occurs during use resulting in accumulation of gasoline or diesel, water, metals, metal oxides, and combustion products (including PAHs) within the oil. Engine efficiency, frequency of oil changes, and mileage of the vehicle can effect the composition of used oils. The concentrations of metal oxides in used engine oil vary with the fuel type and the mechanical condition of the engine. Of all metals found in engine oil, lead has been found in the highest concentrations however, with the introduction of unleaded fuels lead concentrations in used engine oils have decreased. Zinc, copper, chromium, and nickel are also found in used engine oils (Hewstone, 1994).[3] In the past, small amounts of polychlorinated biphenyls (PCBs) were incorporated into transmission fluids to control swelling of rubber seals and in the 1980s PCBs were detected in used oil samples in concentrations ranging from 7 – 65 ppm. Commercial PCB production has since ceased and since the 1990s it is unlikely that PCBs have been present in used engine oils (Tolbert, 1997).

Disposal of used engine oils typically involves collection in sealed containers followed by recycling by burning as fuel or refining (Tolbert, 1997).

The primary route of exposure to used engine oils is by dermal contact during changing of oil or working with contaminated engine parts. To avoid loss of engine oil through volatilisation, engine oils are manufactured to ensure low volatility and the typical task scenarios will not generate aerosols. It is therefore very unlikely that there is inhalation exposure to used engine oils. Dermal exposure to used engine oils has been associated with skin tumorigenic activity, which has been attributed to the PAH content of used engine oils (Steinsvåg *et al*, 2007 and IARC, 1998). Other mineral oils such as metalworking fluids have also been associated with sinonasal, lung and bladder cancer. However, as inhalation exposure to used engine oils is unlikely it is considered that there is little risk of sinonasal and lung cancer from exposure. Bladder cancers associated with mineral oils have been linked to PAHs in oils. All of the work that has linked mineral oils and PAHs to bladder cancer has been based on inhalation exposure and none have studied the relationship between dermal exposure and bladder cancer; however, it should be noted that dermal contact with used engine oils may result in systemic absorption of PAHs and this could potentially lead to bladder cancer.

1.4 RISKS TO HUMAN HEALTH

1.4.1 Introduction

Skin cancer can be classified depending on the type of cells that are affected:

- Melanoma occurs in the cells that produce skin pigment (melanocytes) and is the less common but more dangerous than the other forms;
- Basal cell carcinoma arises in the cells in the lowest layer of the epidermis and is the commonest type of skin cancer;
- Squamous cell carcinoma involves cells in the middle layer of the epidermis.

Squameous and basal cell skin cancer are grouped as non-melanoma skin cancer (NMSC). It is NMSC that we are mainly concerned with in connection with exposure to used engine oils.

[3] ATSDR Toxicological Profile for Crankcase Mineral Oil

Non-melanoma skin cancer is the most common malignant neoplasm in Caucasian populations around the world. The main environmental cause is exposure to sunlight (UV radiation) and as a consequence the disease shows marked variation between and within countries. The incidence is increasing rapidly in white populations in Europe, the US, Canada and Australia; the average increase of NMSC has been 3-8% per year since the 1960s.

If detected early, NMSC is rarely fatal; the cure rates are close to 99%. Treatment is relatively simple with the tumour often being excised in an outpatient clinic. Radiation therapy and/or chemotherapy may also be necessary depending on the stage of tumour development at diagnosis. A consequence of the straightforward treatment is that incidence statistics are less reliable than for other forms of cancer, i.e. cancers with a higher rate of fatality.

There are no reliable statistics about the incidence of NMSC in Europe. Trakatelli *et al* (2007) present data for NMSC incidence in Italy, UK, Slovakia and some other European countries that suggests the incidence is about 100 per 100,000 population per year, which would imply there could be about 500,000 incident cases in the EU each year.

The risk of NMSC is increased among workers in a number of industries and occupations. The responsible agent or agents have been identified for several, but not all of these high-risk workplaces. These include: solar radiation, arsenic and arsenic compounds, coal tar and pitch, soot, benzo(a)pyrene, shale oils, and some mineral oils.

1.4.2 Summary of the available epidemiological literature on risk

A review of the epidemiological evidence of the relationship between occupational mineral oil exposure and cancer in occupations that potentially involved substantial exposure via skin or inhalation, such as metal workers and printers identified three studies that reported results for skin cancer, two conducted in Sweden by Järvholm *et al* (1981) and the other by Roush *et al* (1982) in the USA (Tolbert, 1997). The first study in Sweden reported incidence of skin tumours in turners employed at a bearing ring manufacturing plant between 1960 and 1980. It was found that the workers had a significantly increased SIR for squamous cell carcinoma of 16.6 (p-value<0.001, n=5) when compared to the general male population. Four of the cases were situated on the scrotum and one on the face and all were exposed for more than 13 years. The second study was also conducted in the same plant but investigated all cancers. A slightly different cohort was used and seven cases of scrotal skin cancer were observed in turners who were exposed for at least 5 years during 1958-1983; unfortunately no risk estimate could be calculated, as there were no cases expected. The third study in Connecticut also reported a significantly increased risk of scrotal squamous cell carcinoma among workers exposed to metalworking fluids (RR=10.5, 95% CI=4.0-36.9, n=26).

A systematic review of cancer risk among workers exposed to metalworking fluids (MWF) concluded that MWF exposure (primarily straight oil MWF) is associated with increased risk of skin cancer and scrotal cancer (Calvert *et al* 1998). However, as a result of the changes in composition of MWF and the reduction of impurities, current straight oil exposure may be associated with a substantially reduced risk of these two cancers. In addition to the three studies mentioned above, four other studies reporting results for skin cancer were reviewed; one cohort mortality study in Michigan and three proportionate mortality studies, all in the USA. A cohort study by Eisen *et al* (1992) of white autoworkers reported skin cancer mortality (not stated whether melanoma and NMSC) in three automobile plants, although no significant excesses in risk were observed (Plant 1: SMR=0.92, 95% CI=0.29-1.13, n=10, Plant 2: SMR=1.06, 95% CI=0.53-1.89, n=11 and Plant 3: SMR=1.27, 95% CI=0.51-2.62). Two of the three proportionate mortality studies were of ball-bearing plant workers, one by Silverstein *et al* (1988) showing a reduced risk (PMR=0.92, 95% CI=0.25-2.34, n=4) and the second by Park *et al* (1988) showing an increased risk (PMR=1.88, 95% CI=0.51-4.80, n=4), although the paper appears to indicate that all skin cancers were melanomas. The third was of engine plant workers (Vena *et al* 1985) study conducted in New York; a non-significant reduction in risk for skin cancer of 0.60 based on only 1 death (not stated whether NMSC or melanoma).

Eisen *et al* (2001) published an update to the paper previously described by Calvert. In total, 46,399 automobile workers with potential exposure to MWF were investigated for mortality. Two risk estimates were produced; one for the whole study period and one for the most recent 10-years of follow-up (excluding the first 3 years of employment). Follow-up of three automobile plants in Michigan was conducted over the period 1941-1994. An industrial hygienist visited each plant in order to determine exposure to MWF by assigning a type of MWF to each department and specific job. Cumulative exposure was determined for each worker based on individual job histories (type of job and length held that job and estimated exposure time to MWF). For the whole study period no increased risk of skin cancer was observed (white male: SMR=0.64, 95% CI=0.45-0.89, n=35 and African American male: SMR=0.97, 95% CI=0.20-2.85, n=3). For the most recent years of follow-up only African American males were observed to have an increased risk of skin cancer with an SMR of 1.27 (95% CI=0.14-5.57, n=2); white males again were observed to have a reduced risk (SMR=0.32, 95% CI=0.13-0.66, n=7). Further investigation showed that soluble MWF used in grinding was associated with an increased risk of skin cancer, particularly with the heaviest exposure. Unfortunately the results from this study are ambiguous, as the results are stated as being for skin cancer.

A study by Mitropoulos and Norman (2005) investigated the associations between occupational and non-occupational exposures and the risk of squamous cell carcinoma (SCC) in a population based case-control study in Arizona, the South Eastern Arizona Health Study-2. All cases were residents of the Tucson Arizona metropolitan area who had their first pathologically confirmed diagnosis of non-metastatic skin SCC within four months of ascertainment. Cases were 30 years of age or more with no history of skin or non-skin carcinoma; only non-Hispanic and Hispanic Caucasian cases were eligible for inclusion. Population-based controls were selected using a random digit dialling method. Controls were frequency matched to the cases by age category (± 5 years) and by gender. All subjects completed an extensive interview that sought information on demographics, personal and family medical history, history of sun exposure and exposure to other environmental and chemical agents, occupational history, history of smoking and alcohol consumption. There was slightly elevated risk associated with automobile and machine work (OR=1.21, 95%CI 0.48-3.06), adjusted for skin reaction to sun exposure, history of actinic keratoses, and current number of freckles.

1.4.3 Choice of risk estimates to assess health impact

The studies report results for NMSC giving varying outcomes, both negative and positive. In addition, some do not clearly distinguish between melanoma and NMSC e.g. the "skin cancers" in the Eisen *et al* (2001) paper of car industry workers are in fact all melanomas (Kriebel, personal communication). The paper by Mitropoulos and Norman (2005) focussed on squamous cell carcinoma in a population based case-control study. There was slightly elevated risk associated with automobile and machine work (OR=1.21, 95%CI 0.48-3.06), adjusted for skin reaction to sun exposure, history of actinic keratoses, and current number of freckles. This has been used for the low level of exposure (automobile and motorcycle mechanics). As many studies give negative risk estimates the RR for background levels of exposure (recycling workers) has been taken as 1.

2 BASELINE SCENARIOS

2.1 STRUCTURE OF THE SECTOR

Engine oil is used for lubrication of various internal combustion engines. While the main function is to lubricate moving parts, it also cleans, inhibits corrosion, improves sealing, and cools the engine by carrying heat away from moving parts. Used engine oil can be recovered to be used as a fuel in order to save resources. In some Member States used oil is collected by registered waste carriers or it may be taken to dedicated oil banks (e.g. the Oil Bank Line[4] is a database of all oil banks in the UK).

For the purposes of this study, we considered Eurostat data for 2006 for certain sectors that match the activities related to the minerals oils industry. These are set out in Table 2.1.

Table 2.1 Sectors from Eurostat considered for this study

Sector	**NACE Code (v.1)**	**Description**
Maintenance and Repair of Motor Vehicles	50.2	This class includes: - maintenance and repair of motor vehicles: - mechanical repairs - electrical repairs - electronic injection systems repair - ordinary servicing - bodywork repair - repair of motor vehicle parts - washing, polishing, etc. - spraying and painting - repair of screens and windows - repair of motor vehicle seats - tyre and tube repair, fitting or replacement - anti-rust treatment - installation of parts and accessories not as part of the manufacturing process

[4] Available at: http://www.oilbankline.org.uk/

Sector	NACE Code (v.1)	Description
		This class excludes: - retreading and rebuilding of tyres, see 22.11
Sales, maintenance and repair of motorcycles and related parts and accessories	50.4	This class includes: - wholesale and retail sale of motorcycles, including mopeds - wholesale and retail sale of parts and accessories for motorcycles (including by commission agents and mail order houses) - maintenance and repair of motorcycles This class excludes: - wholesale of bicycles and related parts and accessories, see 46.49 - retail sale of bicycles and related parts and accessories, see 47.64 - renting of motorcycles, see 77.39 - repair and maintenance of bicycles, see 95.29
Recycling of non-metal waste and scrap	37.2	This class includes the processing of metal and non-metal waste and scrap and other articles into secondary raw materials, usually involving a mechanical or chemical transformation process. Also included is the recovery of materials from waste streams in the form of (1) separating and sorting recoverable materials from non-hazardous waste streams (i.e. garbage) or (2) the separating and sorting of commingled recoverable materials, such as paper, plastics, used beverage cans and metals, into distinct categories. Examples of the mechanical or chemical transformation processes that are undertaken are: - mechanical crushing of metal waste from used cars, washing machines, bikes etc. - mechanical reduction of large iron pieces such as railway wagons - shredding of metal waste, end-of-life vehicles etc. - other methods of mechanical treatment as cutting, pressing to reduce the volume - reclaiming metals out of photographic waste, e.g. fixer solution or photographic films and paper - reclaiming of rubber such as used tyres to produce secondary raw material - sorting and pelleting of plastics to produce secondary raw material for tubes, flower pots, pallets and the like - processing (cleaning, melting, grinding) of plastic or rubber waste to granulates - crushing, cleaning and sorting of glass - crushing, cleaning and sorting of other waste such as demolition waste to obtain secondary raw material - processing of used cooking oils and fats into secondary raw

Sector	NACE Code (v.1)	Description
		materials - processing of other food, beverage and tobacco waste and residual substances into secondary raw materials This class excludes: - manufacture of new final products from (whether or not self-manufactured) secondary raw materials, such as spinning yarn from garneted stock, making pulp from paper waste, retreading tyres or production of metal from metal scrap, see corresponding classes in section C (Manufacturing) - reprocessing of nuclear fuels, see 20.13 - remelting ferrous waste and scrap, see 24.10 - materials recovery during waste combustion or incineration process, see 38.2 - treatment and disposal of non-hazardous waste, see 38.21 - treatment of organic waste for disposal, including production of compost, see 38.21 - energy recovery during non-hazardous waste incineration process, see 38.21 - treatment and disposal of transition radioactive waste from hospitals etc., see 38.22 - treatment and disposal of toxic, contaminated waste, see 38.22 - wholesale of recoverable materials, see 46.77

We recognise that the number of workers and enterprises affected by the proposed intervention are likely to be an overestimate since the NACE codes: include activities in which workers may not necessarily be exposed to used engine oils. In the absence of any more precise or comprehensive publicly available data, the Eurostat data was considered suitable for this study and the majority of cost information from Eurostat will be average enterprise data rather than sector totals. Table 2.2, Table 2.3 and Table 2.4 show the total number of people employed and number of enterprises.

Table 2.2 Number of workers employed in affected industries

Sector	NACE code	Number of employees (2006)	Number of employees (2007)
Maintenance and repair of motor vehicles	50.2	1,293,721	1,368,526
Sales, maintenance and repair of motorcycles and related parts and accessories; and	50.4	105,046	113,231
Recycling of non-metal waste and scrap	37.2	70,708	76,743
Total	**-**		

Source: Eurostat classification of economic activities - NACE Rev.1.1 - Number of Enterprises

Table 2.3 provides a breakdown of the number of enterprises by Member State.

Table 2.3 Breakdown of the number of enterprises across the EU 27 (2006)

Member State	Maintenance and repair of motor vehicles (50.2)	Sales, maintenance and repair of motorcycles and related parts and accessories (50.4)	Recycling of non-metal waste and scrap (37.2)
BE-Belgium	7469	1093	245
BG-Bulgaria Bulgaria	4015	148	30
CZ-Czech Republic			283
DK-Denmark	4639	337	23
DE-Germany	35786	4054	740
EE-Estonia	907	51	18
IE-Ireland	3255	101	25
GR-Greece			0
ES-Spain	46349	4123	178
FR-France			1588
IT-Italy	83824	7354	1098
CY-Cyprus	2177	166	11
LV-Latvia	1731	64	17
LT-Lithuania	5181	37	28
LU-Luxembourg	118	21	11
HU-Hungary	8807	508	134
MT-Malta			
NL-Netherlands	4150	1145	180
AT-Austria	3974	380	76
PL-Poland	46933	990	835
PT-Portugal	18660	2600	231
RO-Romania	7583	344	316
SI-Slovenia	2561	93	28
SK-Slovakia	655	24	48
FI-Finland	5405	330	27
SE-Sweden	11532	1350	97
UK-United Kingdom	34224	2527	1107
EU 27	**336,171**	**27,639**	**7,374**

The Eurostat data also indicates that the majority of the sectors are made up of SMEs, with an average composition of 90% of enterprises employing less than 10 people and over 95% of enterprises employee less than 50 workers (Table 2.4).

Table 2.4 Breakdown of enterprises by employee size (2006)

Size of enterprise by number of employees:	Maintenance and repair of motor vehicles (50.2)	Sales, maintenance and repair of motorcycles and related parts and accessories (50.4)	Recycling of non-metal waste and scrap (37.2)
<10	95%	96%	80%
10 - 19	4%	3%	11%
20 - 49	1%	1%	7%
50 - 250	0%	0%	2%
> 250	0%	0%	0%

Source: Eurostat classification of economic activities - NACE Rev.1.1: Number of Enterprises by Size of Enterprise (number of Employees)

2.2 PREVALENCE OF USED ENGINE OIL EXPOSURE IN THE EU

Engine mechanics that work with automobile parts contaminated with engine oil or who change engine oil are likely to be exposed to used engine oils by skin contact. Workers involved in the collection and recycling of used engine oil may also be exposed. CAREX estimates of prevalence of exposure to mineral oils or used engine oils in the EU are not available. We have estimated the prevalence of exposed workers (Table 2.5) from the number of workers reported to be employed in the EUROSTAT structural business statistics database in the following industries:

- NACE 50.2 – Maintenance and Repair of Motor Vehicles;
- NACE 50.4 – Sales, maintenance and repair of motorcycles and related parts and accessories; and
- NACE 37.2 – Recycling of non-metal waste and scrap.

In all three industries we assumed that all workers in the following International Standard Classification of Occupations (ISCO) occupational groups are exposed.

- Technicians and associate professionals;
- Service workers and shop and market sales workers;
- Craft and related trades workers;
- Plant and machine operators and assemblers; and
- Elementary occupations.

This has probably resulted in overestimates of prevalence in these industries as it is unlikely that all workers in the above occupational groups are exposed.

The proportion of workers in the above occupational groups in NACE group G (Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods) and NACE group D (Manufacturing [includes recycling]) was obtained from the Labour Force Survey available on the EUROSTAT database.[5]

There are also likely to be exposed workers within the railway, water and air transportation industries (NACE 60.1, 61 and 62 respectively); however, insufficient data were available to estimate prevalence of exposure in these industries. We believe that these workers comprise a small proportion of the whole exposed population.

[5] Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

Table 2.5 Estimated Prevalence of Exposure to Mineral Oils as Used Engine Oils in the EU

	Percentage of Workers Exposed		Number of Exposed Workers Total			
	NACE G	NACE D	NACE G		NACE D	Total
			NACE 50.2	NACE 50.4	NACE 37.2	
Austria	73	80	19778	1238	502	21517
Belgium	61	74	12610	1072	1856	15538
Bulgaria	75	86	8097	166	346	8609
Cyprus	75	84	3653	150	73	3877
Czech Republic	75	85	32445	254	1714	34414
Denmark	73	77	13093	531	NA*	13625
Estonia	70	79	2340	47	260	2646
Finland	76	70	8683	651	118	9452
France	61	78	73053	9714	11652	94419
Germany	68	73	132688	11405	9375	153469
Greece	55	80	19597	4018	0	23615
Hungary	73	83	16843	977	800	18620
Ireland	66	68	5278	165	203	5646
Italy	62	82	147983	13536	7839	169358
Latvia	76	81	5601	139	101	5841
Lithuania	66	79	8924	72	382	9377
Luxembourg	56	70	444	37	81	561
Netherlands	69	68	15541	2370	1767	19678
Poland	74	82	80649	1074	5305	87028
Portugal	68	83	30511	3004	1103	34617
Romania	79	86	27941	216	2065	30222
Slovakia	77	88	3048	39	554	3641
Slovenia	74	82	4768	126	295	5189
Spain	69	81	107060	8163	2772	117995
Sweden	70	77	17502	1794	680	19976
United Kingdom	67	62	126173	7705	7319	141197
Total			924299	68663	57162	1050124

*NA: Not Available
No Data Available for Malta

The estimated number of male and female employees in each industry group in each EU member state is shown in Appendix 8.1. The estimates were obtained by applying the average male to female employee ratio for the industry group for each country to the total number of employees. Male to female employee ratios were calculated with data from the Labour Force Survey.

2.3 LEVEL OF EXPOSURE TO USED ENGINE OILS

2.3.1 Estimation of exposure levels

There is no available data on levels of dermal exposure to used engine oil. In addition to carcinogenesis, dermal contact with used engine oil can result in dermal irritation and dermatitis and controls to prevent or reduce dermal exposure have been recommended by engine oil manufacturers for over twenty-five years. Dermal exposures to workers in NACE 50.2 and 50.4 (automobile and motorcycle mechanics) are expected to be low and exposure to workers in NACE 37.2 (recycling workers) are expected to be at background levels (Kahsnitz *et al*, 1982).

2.3.2 Temporal change in exposure

Current exposure levels are probably lower than historic levels due to improvements in engine efficiency, decreased frequency of required oil changes, reduced leakage from engines, and the guidance from manufacturers (Kahsnitz *et al*, 1982). It is also likely that there has been increased attention to personal hygiene amongst workers exposed to engine oils due to increased guidance from industry and government, along with changes in attitudes about skin and clothing contamination with oils. There is also likely to be greater use of personal protective equipment such as disposable gloves and workers may also use pre-work creams (barrier creams) to attempt to minimise the risk of dermatitis or other effects of the oil on the skin.

2.4 HEALTH IMPACT FROM CURRENT EXPOSURES

2.4.1 Background data

The occupational cancers associated with exposure to used engine oils are shown in Table 2.6, along with a summary of the information used in the health impact assessment.

Table 2.6 Occupational cancers associated with exposure to Used Engine Oils

Cancer site	**NMSC**	
ICD-10 code	C44	
IARC group for carcinogen	1	
Strength of evidence for cancer site [1]	Strong	
Latency assumption	10-50 yrs	
Source of forecast numbers - deaths	C44 not available in Eurostat or WHO databases, uprate GB to EU on population ratio only	
Source of forecast numbers - registrations	C44 not available in Eurostat or WHO databases, uprate GB to EU on population ratio only	
Exposure levels	**Relative Risk (RR)**	**Source of RR**
"High"	-	
"Low"	1.21 (0.48, 3.06)	Mitropoulos and Norman (2005)
"Background"	1	

[1] Based on Siemiatycki *et al*, 2004

2.4.2 Exposed numbers and exposure levels

Industry sectors, their NACE codes, classifications to High/Medium/Low/Background exposure as applicable for the mid 1970s were given in the previous section. There is no inhalation exposure and it is difficult to quantify the impact of interventions to reduce dermal exposure. Therefore estimated average exposure level (GM) and measure of variability (GSD) for NACE industries used, and a percent decline are not available.

We present data for a "baseline" scenario, which for all industries assumes a standard change in employed numbers up to the 2021-30 estimation interval and constant levels of employment thereafter.

2.4.3 Forecast cancer numbers

No European estimates were available for NMSC (ICD10 C44). Therefore, deaths (for 2005) and registrations (for 2004) for Great Britain were used, uprated in proportion to individual EU country populations in 2005 by age and sex. The forecast numbers of deaths and registrations by country used to estimate attributable numbers are in Appendix 8.2.

2.4.4 Results

The cancer deaths and registrations attributed to occupational exposure to used engine oils for the baseline scenario are presented per year for the target years given and are based on the all working age cohort of currently (2006) exposed workers. Attributable fractions and numbers of deaths and registrations, and Years of Life Lost (YLLs), Years Lived with Disability (YLDs) and Disability Adjusted Life Years (DALYs), are estimated.

Although the exposure data is insufficient to suggest that there is any change in exposure over time, employment numbers are expected to change over time and thus a dynamic baseline has been used.

A summary of the results for the total EU is in Table 2.7 below.

Table 2.7 Results for the baseline forecast scenario, total EU (27 countries), men plus women

Scenario	**All scenarios**		**Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.**			
EU Total	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Numbers ever exposed	3,125,708	3,714,482	4,546,071	5,383,591	5,983,701	6,354,589
Proportion of the population exposed	0.87%	0.98%	1.17%	1.37%	1.53%	1.65%
NMSC						
Attributable Fraction	0.15%	0.17%	0.21%	0.26%	0.32%	0.35%
Attributable deaths	7	9	14	22	30	36
Attributable registrations	916	1,188	1,717	2,415	3,095	3,554
'Avoided' cancers						
YLLs	71	94	138	202	268	315
DALYs	93	122	179	258	341	398

The attributable deaths in the EU 2010 from previous used engine oil exposures were predicted to be small with only 7 attributable NMSC deaths. The estimated deaths and cancer registrations steadily increase over the following 50 years with 36 attributable NMSC deaths in 2060. The corresponding estimated attributable fraction (AF) for NMSC increases from 0.15% in 2010 to 0.35% in 2060. DALYs are also expected to increase for NMSC in the baseline scenario from 93 years in 2010 to 398 years in 2060.

The numbers of attributable skin cancers is forecast to increase almost four-fold up to 2060 from 916 attributable registrations in 2010 to 3,554 registrations in 2060. This is due to a doubling of the number exposed in the risk exposure periods because of likely changes in employment demographics leading to skin cancers in 2010 to 2060 (as numbers employed in the service sector, including NACE codes 50.2 and 50.4, are estimated to have doubled since 1961-70 and will increase by a further third up to 2021-30). In addition, an ageing population has led to a forecast increase in skin cancer registrations up to 2060. Note, that while we believe conditions have improved there is no basis on which to judge the actual reduction in exposure and so we have had to assume that there will be no change in exposure over time.

Results for the baseline scenario (1) are in Figure 2.1 (attributable registrations), Figure 2.2 (AFs) and Figure 2.3 (DALYs) for men plus women for the total EU (27 countries) for NMSC.

Full results are given in Appendix 8.3 for men plus women by country in Table 8.3.1 and Table 8.3.2. A breakdown of attributable numbers by industry is in Table 8.3.3 and Table 8.3.4. Data for men and women separately, and by industry within country, are available in supplementary spreadsheets (*MineralOils Report data.xls)*.

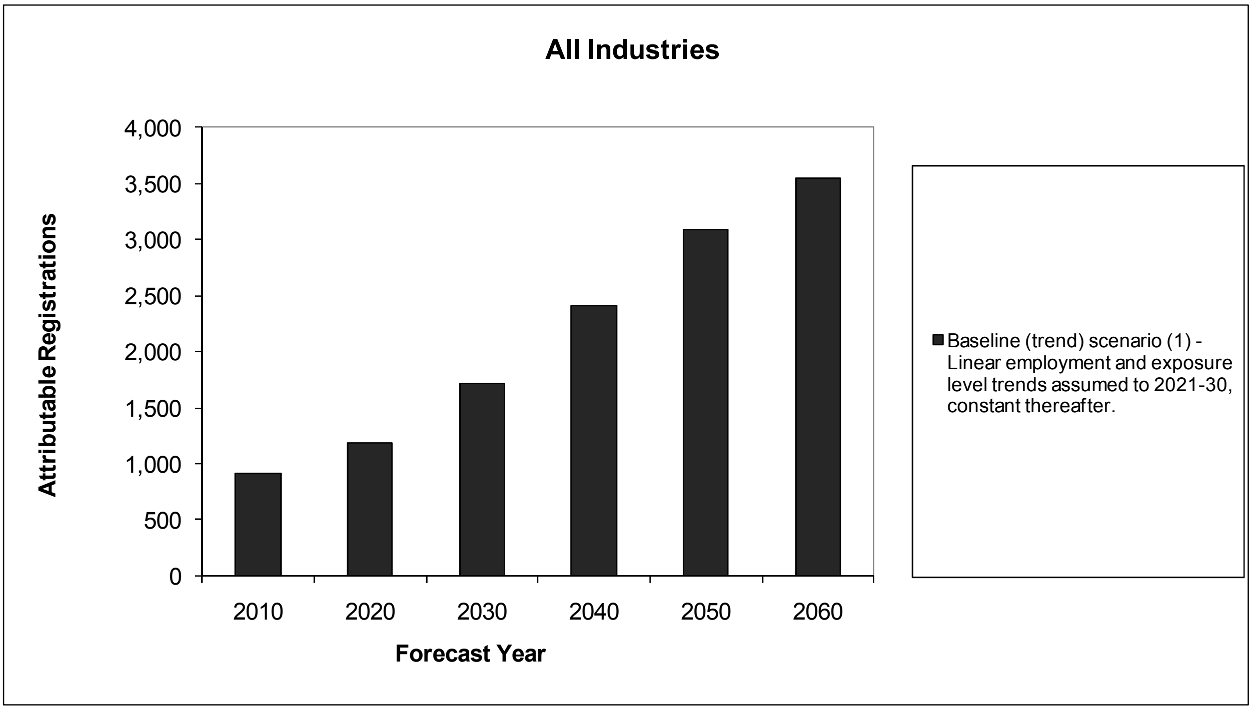


Figure 2.1 Results for the baseline scenario (1) – Occupation Attributable cancer registrations, NMSC, men plus women

Figure 2.1 shows that the number of registrations for NMSC attributable to mineral oil exposure is predicted to increase over the next 50 years.

Figure 2.2 shows that the attributable fraction is also predicted to increase over the period up to 2060. The attributable fraction increases from approximately 0.15% in 2010 to approximately 0.35% in 2060.

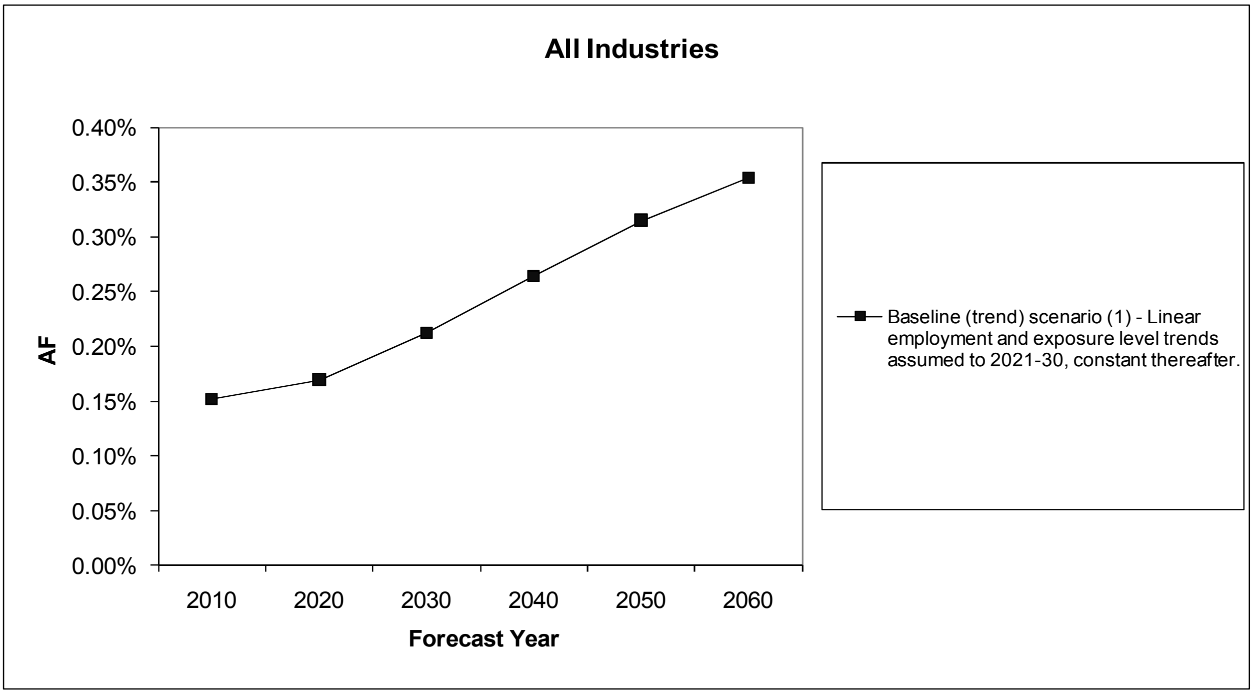


Figure 2.2 Occupation Attributable Fractions, NMSC

The estimated DALYs increase from just under 100 in 2010 to just under 400 in 2060 for the baseline scenario (Figure 2.3)

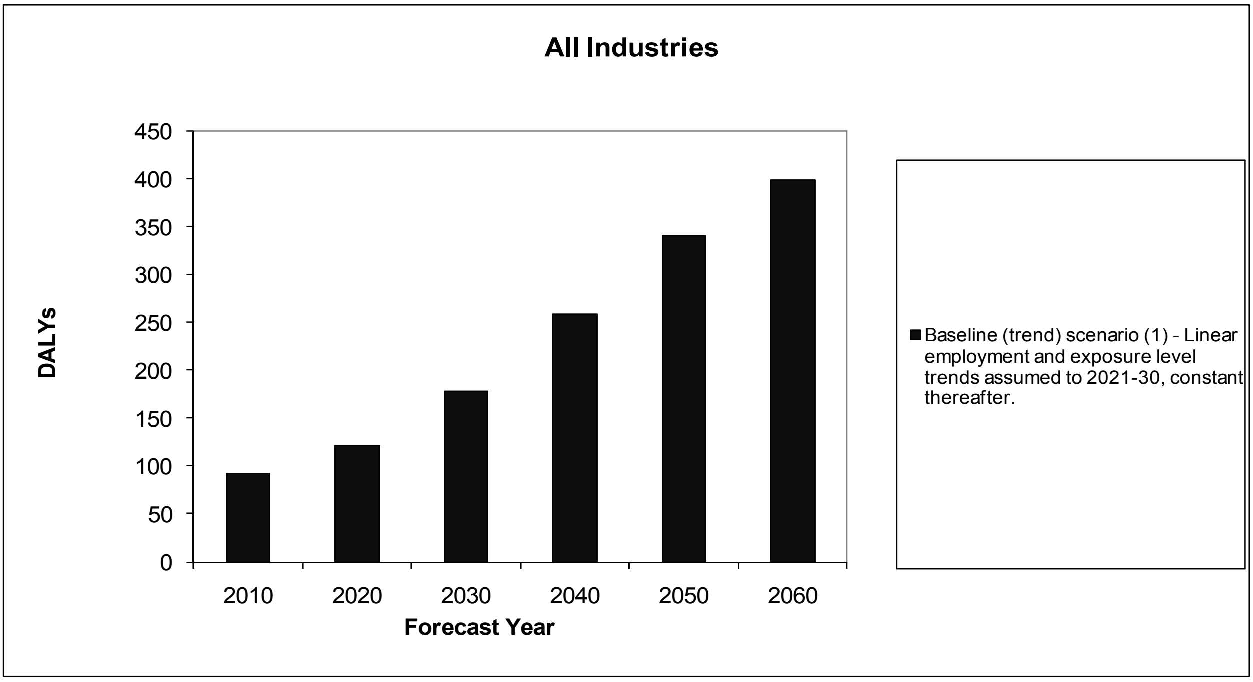


Figure 2.3 Occupation Attributable DALYs, NMSC

Note that the health impacts are likely to be overestimates because the estimated numbers of people exposed was based on employment in sectors where exposure was likely to occur but we had no data on the number of people actually exposed within these sectors. In addition the risk estimates are based on historic epidemiological data and we have not been able to make any allowance for improvements in work practices such as improved personal hygiene or the use of gloves or other items of personal protective equipment.

2.5 POSSIBLE COSTS ASSOCIATED WITH NOT MODIFYING THE DIRECTTIVE

2.5.1 Health impacts – possible costs under the baseline scenario

Introduction

The health data (cancer registrations and Years of Life Lost - 'YLL') for the baseline in which there are no further modifications to the Carcinogens Directive were described above in Section 2.4. These data indicate that there are predicted to be a high number of cancer registrations (around 130,000 over the period 2010-2070[6]) and YLLs (11,000 over the period 2010-2070[6]) from NMSC cancer resulting from future exposure to mineral oils.

There is a predicted increase in registrations and YLLs over the time period of this study (2010-2070) under the baseline scenario. As explained in Section 2.4.4, this is due to predicted employment demographic changes, ageing European populations and overall population increase where no change in average exposure levels is expected.

Method in brief

Using the health data (cancer registrations and YLL), it is possible to monetise the costs under the baseline by estimating the:

- Life years lost – This is calculated by using the YLL and multiplying this by a valuation of the Value of Life Year Lost (VLYL). This gives a value for the time (in years) lost as a result of premature death.
- Cost of Illness (COI) – This is a monetary cost of the time spent with cancer. In this study, a unit COI estimate is multiplied by the number of cancer registrations to give a total value for COI. (COI is often the main market-based approach in relation to health impact[7]). COI includes the direct and indirect costs of cancer but not the intangible costs (see below).
- Willingness to Pay (WTP) to avoid cancer – WTP is used as an alternative method (high cost scenario) based on publically available, peer reviewed studies on what people would be willing to pay to avoid having cancer. This includes various intangible costs (e.g. disfigurement, functional limitations, pain and fear) and in some cases also includes the costs associated with life years lost.

Because exposure to mineral oils can lead to NMSC, a modification of the method used to estimate costs of health impacts was required as compared to other

[6] Note health estimates are provided for "snap-shot" years; 2010, 2020, 2030 etc. Results for a "snap-shot" year are assumed to be representative for the relevant time period (i.e. 2010 is also representative for 2010-2019) so impacts are multiplied by 10.

[7] ECHA (2008) "Applying SEA as part of restriction proposals under REACH" Available at: http://echa.europa.eu/doc/reach/sea_workshop_proceedings_20081021.pdf

substances assessed in the current project. A different set of cost estimates was used for NMSC, as set out below.

Costs for NMSC are presented in Table 2.8. Costs for NMSC are based on a simple meta-analysis of various studies examining the economic costs of NMSC. Of particular relevance was a study by Miljoministeriet (2004) in which the direct costs of NMSC and willingness to pay (WTP) studies to avoid permanent scars were reviewed. The study (along with other studies) suggests that NMSC can typically be treated within a year and is assumed, in general, to not result in death.

The cost that includes WTP to avoid scarring (249,424 DKK in 2002 prices) is taken from the Miljoministeriet (2004) study and converted to euros (€38,827 in 2009 prices) and is used as a high estimate. The study also provides a possible low COI estimate of €2,926 (18,795 DKK in 2002 prices). A comparable estimate is also derived from Morris *et al* (2005) which estimates COI at €2,601 in 2009 prices (based on an estimate of £1,413 in 2002 GBP prices). The latter is used as the low estimate in the current analysis.

Another study by O'Dea (2009) estimated the overall costs of NMSC to New Zealand. If divided by the number of incidents, this gives a broad estimate of €538 (867 NZD in 2007/08 prices) per incident. However this was excluded as the per-registration costs was not explicitly estimated and also may not necessarily be representative of costs for the EU.

For the purposes of this study, valuations are increased by 2% each year in the future in part to present costs in real terms (i.e. adjusting for inflation in prices) and to reflect the increasing value society's attaches to its health (as economic growth typically increases over a long period of time).[8]

Table 2.8 Summary of cost variables used in this study (€ 2009 prices)

Cost/benefit elements	Low scenario	High scenario
VLYL - Each year lost	€ 50,393	€ 50,393
COI or WTP - Unit cost (per cancer registration)	€ 2,601	€ 38,827 (WTP)

Note: As the WTP to estimate relates to not having permanent scars and does not include the costs associated with life years lost, the high scenario also incorporates the impacts of any life years lost. This differs from the approach used for other types of cancer whereby the WTP already includes life years lost (and is therefore excluded to avoid double counting benefits).

All costs and benefits over time in this study are discounted using a 4% discount rate as recommended by the European Commission's Impact Guidelines[9]. In order to assess the effect that discounting has on the results ('sensitivity analysis'), we have also presented estimates that take into consideration a declining discount rate for impacts occurring after 30 years and no discounting.

The health data shown in section 2.4 are snap-shots (i.e. estimation for the initial year of a ten year period) of the number of cancer registrations, deaths, YLLs in future years at 10 year intervals. In calculating the costs associated with these effects, each snap-shot result is multiplied by 10 in order to derive an estimate for the whole assessment

[8] This is consistent with some other European Commission studies and is standard practice for air quality under the Clean Air for Europe (CAFE) programme.

[9] European Commission impact Assessment Guidelines (Jan 2009) - http://ec.europa.eu/governance/impact/commission_guidelines/docs/iag_2009_en.pdf

time period (for example, 2020 results are multiplied by 10 to give results over the period 2020-2029). This assumes that each snap-shot year is representative of the following 10 years.

The method to valuing health benefits is explained in more detail in the method paper titled *"Valuing health benefits – Method paper".*

Results

The health costs under the baseline scenario are presented in Table 2.9. Health costs are predicted to increase over time. In Section 2.4 the numbers of cancer registrations and YLLs were estimated to increase over time, which is the underlying reason for the increasing health costs. As discussed earlier this is due to predicted employment demographic changes, an ageing population, overall population increase and a static baseline.

Table 2.9 sets out the range of annual health costs for each representative decade. The ranges are based on the high and low cost scenarios (see Table 2.8). The results are also illustrated in Figure 2.4.

It is important to recognise that these estimates are based on numbers of cancer registrations, which are expected to be over 900 per year in 2010 and rising to over 3,000 by 2060. Since there is a large difference in the unit cost (low and high estimates) used for WTP to avoid cancer (see Table 2.8) in addition to the large number of cancer registrations forecasted without further intervention, this explains why there is a large difference between the low and high cost estimates under the baseline scenario.

Some caution is needed with these estimates since we have had to use data from the Labour Force Survey and this will have likely resulted in an overestimate in the number of people who may be exposed, i.e. these figures probably represent an upper limit on the health costs.

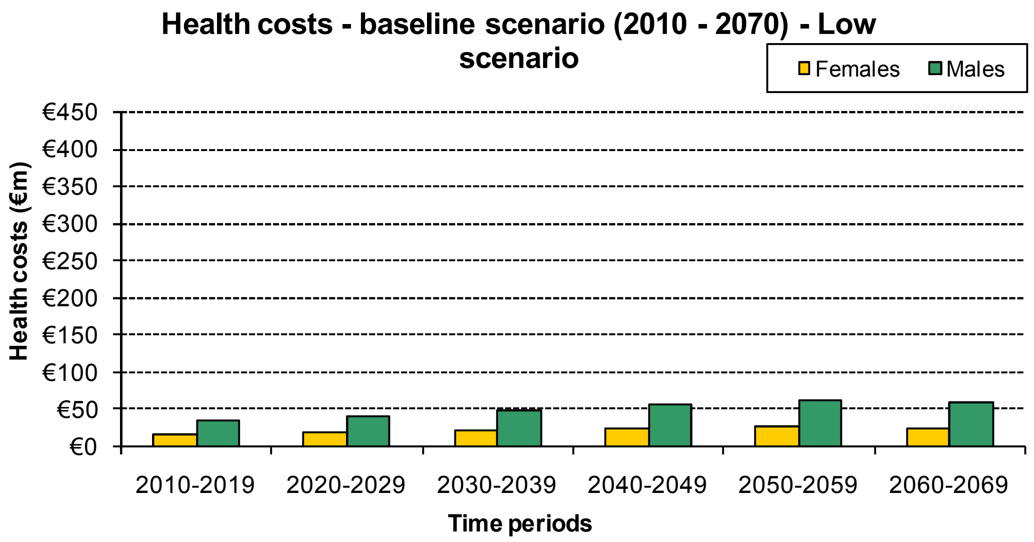
Table 2.9 Health costs - baseline scenario – 2010 to 2070 (Present Value – 2010 €m prices)

Costs by Gender (€m)	2010-2019	2020-2029	2030-2039	2040-2049	2050-2059	2060-2069	Total
Female	17 to 120	18 to 124	22 to 145	25 to 166	27 to 174	26 to 165	136 to 894
Male	37 to 236	40 to 256	49 to 309	58 to 362	63 to 387	61 to 370	307 to 1,920
Total	54 to 356	59 to 381	71 to 454	83 to 528	91 to 562	87 to 535	445 to 2,815

Notes:

- All costs are presented in present value using a discount rate of 4%. The low range is based on low estimates for costs of illness and life years lost. The upper range of costs relate to WTP estimates to avoid having cancer, which include intangible costs associated with having cancer.

- Totals may not match to sums of females and male costs due to underlying small differences in raw data and rounding to whole number



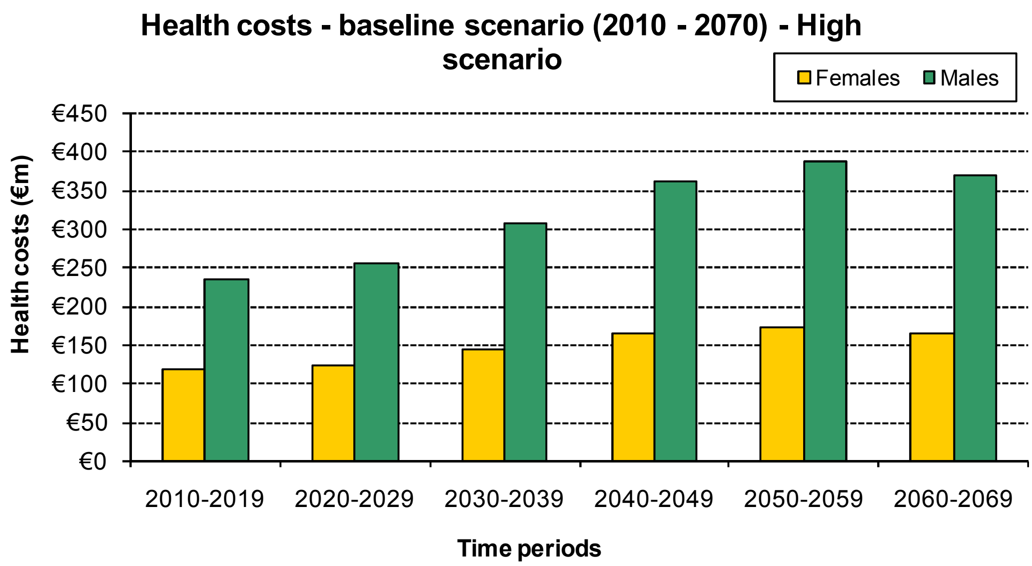


Figure 2.4 Health costs - baseline scenario – 2010 to 2070 (Present Value – 2010 €m prices)

These predicted health costs will affect Member States differently depending upon the overall number of workers within affected industry groups, existing risk management measures (RMMs) and the proportion of males and females within these groups. Figure 2.6 shows that Germany, Italy, Spain and the UK are predicted to have relatively high health costs, followed by Poland and France. The industrial sector estimated to be affected under the baseline is the maintenance and repair of motor vehicles. It is likely that this sector is particularly affected as the primary route of exposure to used engine oils is by dermal contact during changing of oil or working with contaminated engine parts (see Section 1.3). This is shown in Figure 2.7.

Detailed tables are included in Appendix Section 8.4.

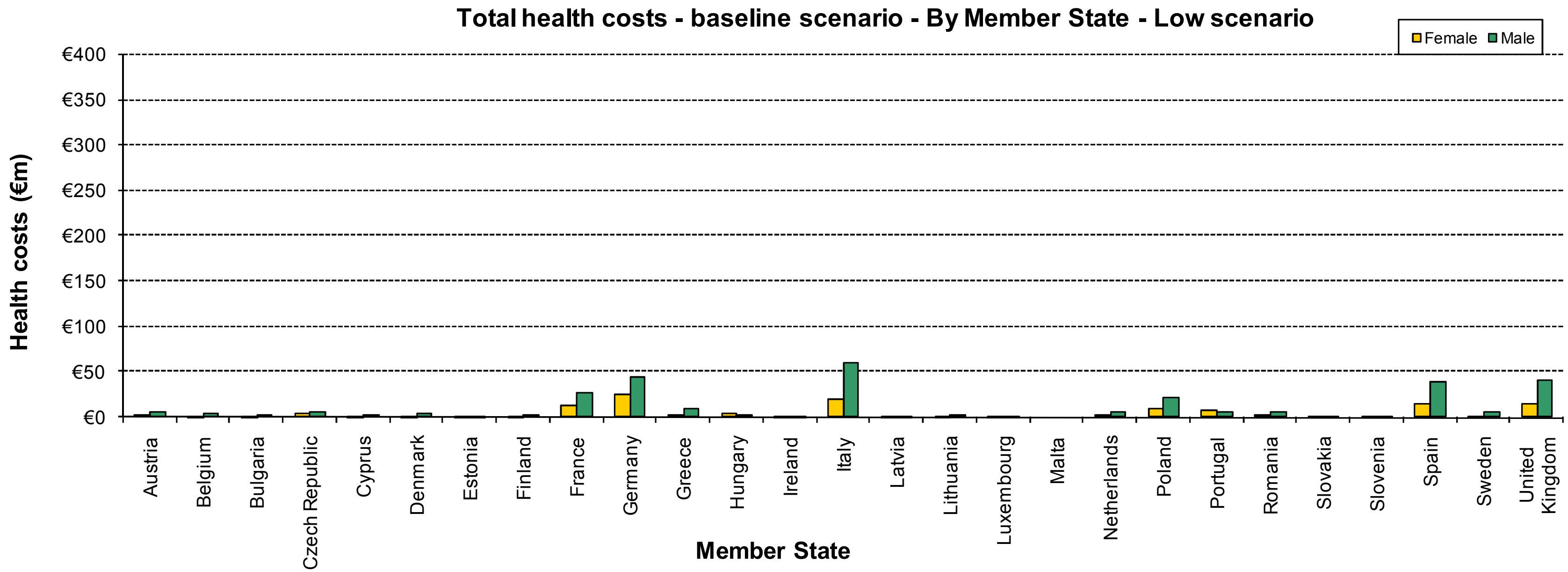


Figure 2.5a Total health costs- baseline scenario – By Member State (Present Value – 2010 €m prices)

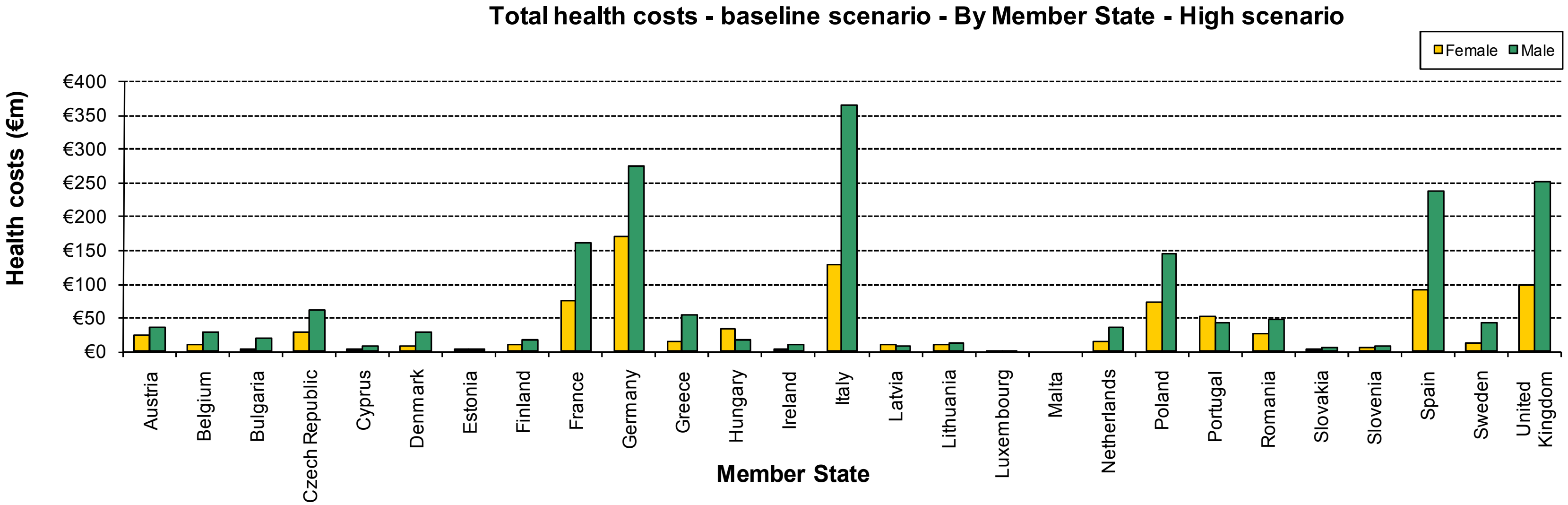
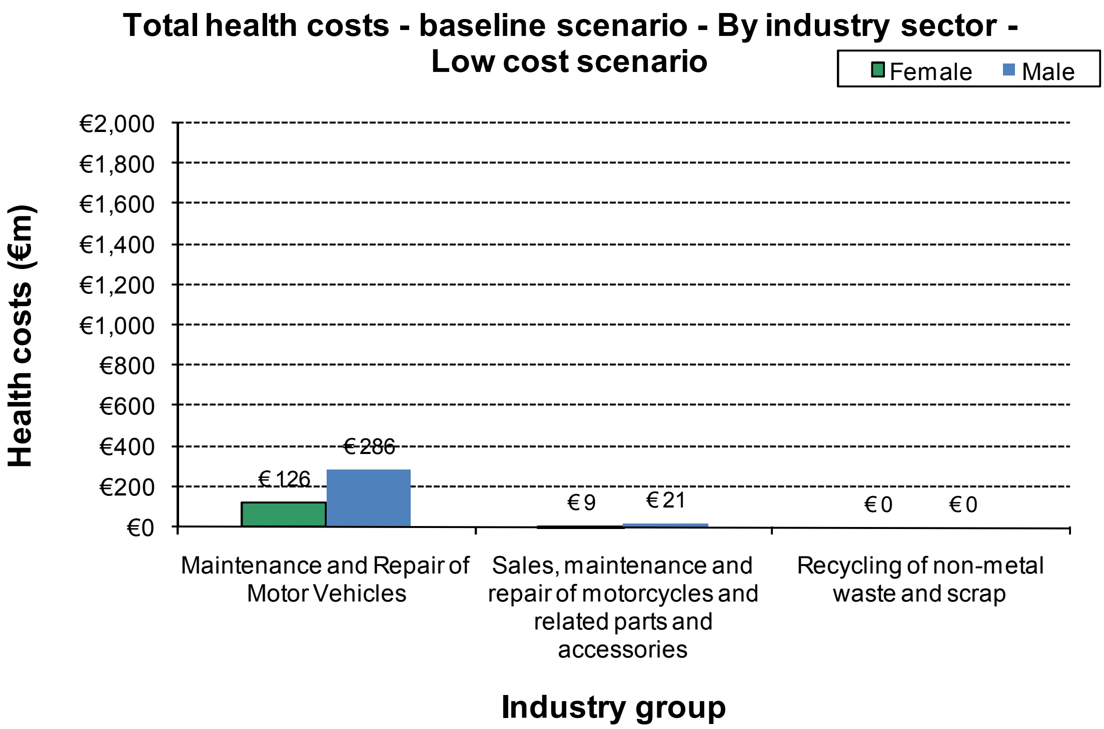


Figure 2.6b Total health costs- baseline scenario – By Member State (Present Value – 2010 €m prices)



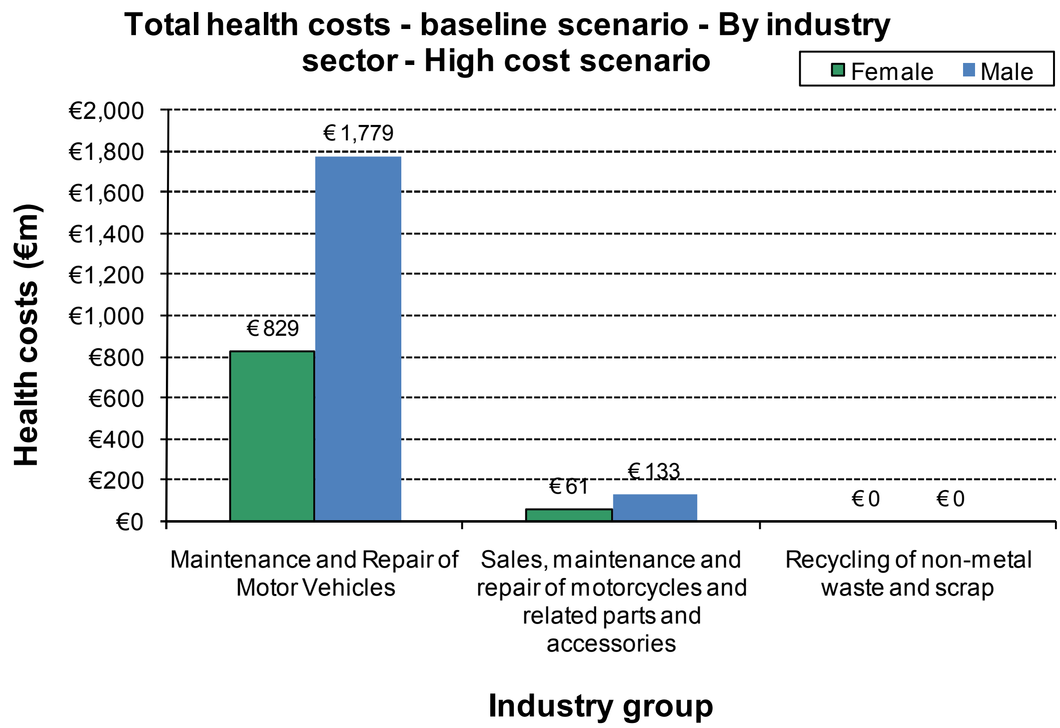


Figure 2.7 Total health costs - baseline scenario - by industry group (Present Value – 2010 €m prices)

In order to present all socio-economic costs and benefits consistently in present value terms, all future costs and benefits have been discounted. The primary approach was to apply the European Commission IA recommended 4% discount rate. Since most health impacts occur over a long period of time relative to costs, the impacts of discounting are significant.

In Figure 3.1 the effects of different discount rates on the overall results are shown, indicating that the impacts of discounting become more pronounced over time. As the number of registrations and YLLs increase over time, the difference between the results when using discounting and with no discounting becomes more apparent.

3 POLICY OPTIONS

3.1 DESCRIPTION OF MEASURES

As discussed in Section 1.2, no occupational exposure limits for used engine oils are known to be in place.

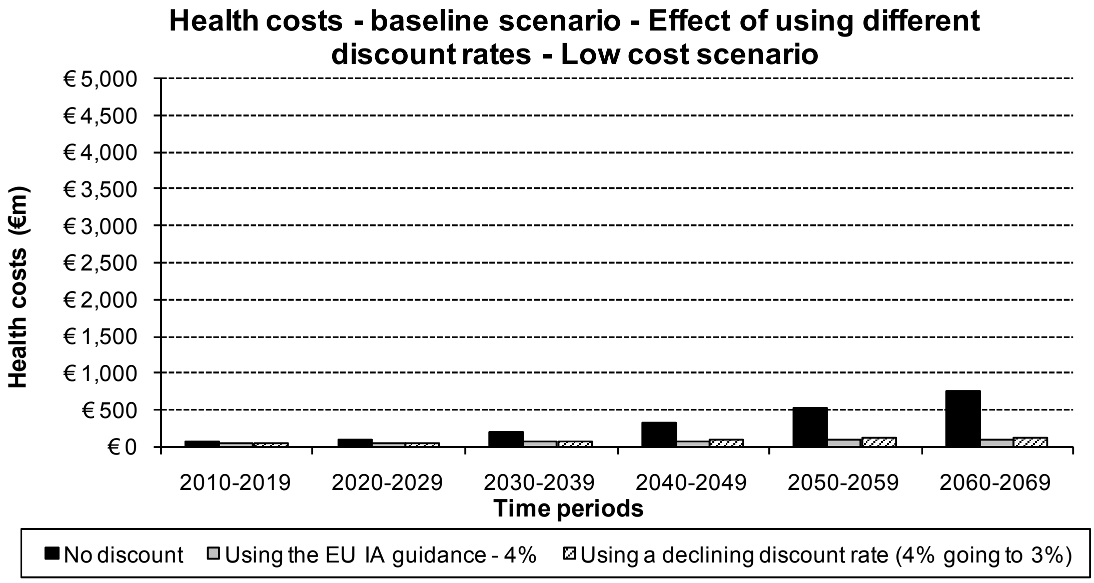
Occupational exposure to mineral oils may occur during prolonged and repeated contact with such oils. Based on the use and the properties of used engine oils, exposure may occur through the following means:

- Direct skin contact with oils and subsequent absorption into the body; and
- Oil-soaked clothing and oily rags kept in overalls.

Specific control measures used to limit exposure to used engine oils include[10]:

- Suitable protective clothing and changing clothes on daily basis;
- Avoid routine skin contact
- Good personal hygiene
- No smoking, eating or drinking permitted in the workplace
- Self-examination for warts, spots etc
- Using suitable gloves (e.g. PVC gauntlets) and barrier creams for handling
- A closed collection system for used oil, including oil drain pans and collection sumps, is recommended[11].

[10] Personal correspondence with Eco Oil in November 2009
[11] Chevron Products Company (2007) Used Motor Oils Factsheet, Available at: http://psglubricants.chevron.com/PSG%5CChevron_ProdSafetyGds%5C7a_UsedMotorOils_Chevron.pdf



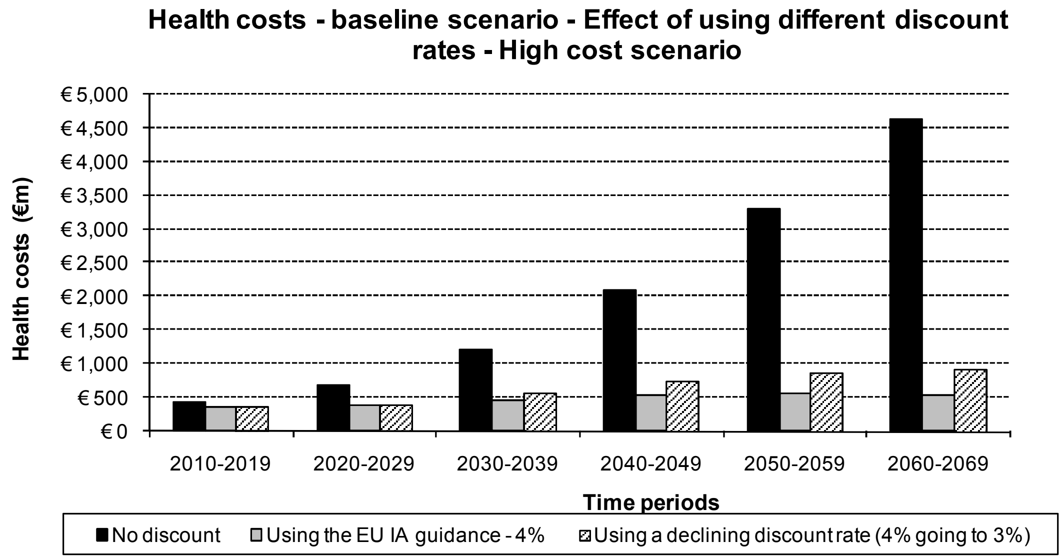


Figure 3.1 Impacts of discounting

Whilst no specific OEL or biological monitoring value has been investigated in the current analysis, it is assumed that including the substance on the Directive would lead to the introduction of additional workplace controls through the various other requirements of the legislation.

3.2 LEVEL OF PROTECTION ACHIEVED

The use of gloves or barrier creams is recommended when working with used engine oils or equipment likely to be contaminated with used engine oils. It is also recommended that workers remove and clean contaminated clothing, avoid keeping contaminated rags in pockets, and wash hands and other parts of the body that come into contact with used engine oils at the end of each task that results in contamination (Hewstone, 1994).[12]

4 ANALYSIS OF IMPACTS

4.1 HEALTH IMPACTS FROM CHANGES TO THE EU DIRECTIVE

4.1.1 Health information

The lack of a suitable OEL for used engine oil and the fact that the main, perhaps the only, relevant route of exposure is via the skin has meant that it was not possible to devise an intervention strategy that could be used to generate a quantitative health impact assessment.

4.1.2 Monetised health benefits

Dermal exposures to workers in NACE 50.2 and 50.4 (automobile and motorcycle mechanics) are expected to be at a low level and exposure to workers in NACE 37.2 (recycling workers) are expected to be at background levels (Kahsnitz *et al*, 1982). However no exposure level data are available and therefore estimates of average dermal exposure levels are not available, meaning that the effects of introducing new standards or controls cannot be tested quantitatively. Therefore no data is presented for alternative scenarios in this section.

Potential health benefits (reductions in cancer registrations, avoided YLLs, etc) of full compliance with best practice have not been modelled due to insufficient data. Whilst full compliance with best practice is unlikely to significantly alter health costs under the baseline due to past exposure (e.g. costs up to 2030/40), compliance with good practice could avoid the health costs associated with future exposure. Therefore a tentative and broad estimate of health benefits could be the total avoided costs associated with getting cancer post 2040 (i.e. avoided future exposure), which is estimated to be around €0.3-1.63bn (see Table 2.9). This is the maximum that could be achieved, assuming that deaths/registrations are reduced to zero – which is unlikely to be practicable. In practice, the avoided health costs are likely to be some proportion of this.

4.2 ECONOMIC IMPACTS

As set out in 2.3.1 the risks of inhalation exposure are estimated to be very low across all sectors affected. Therefore it is reasonable to assume that there is no significant economic costs associated with compliance with an airborne OEL. Given that dermal

[12] Available at: http://www.hse.gov.uk/mvr/priorities/oil.htm

exposure is the main exposure route, it is unlikely that an OEL for concentrations in air would be appropriate.

This section therefore focuses on the possible economic costs associated with reducing dermal exposure. Since a specific EU-wide biological monitoring value has not been proposed (because there is no appropriate metric available) economic costs are based on the general costs associated with improved training, enclosure, housekeeping, personal protective equipment (PPE), which in any case would be considered to be 'best practice', but is not necessarily standard practice. It is not known what the current level of risk management is across the EU relative to best practice.

4.2.1 Operating costs and conduct of business

Compliance costs

In Section 2.2 the numbers of workers potentially exposed to mineral oils (to some level) were estimated to be:

- 1 million workers from the use of mineral oils as used engine oils

It is recognised that the estimate of 1.05m workers exposed is an overestimate which is based on the sum of certain job occupations. However, it is very difficult to get a better estimate due to a lack of data. We have therefore chosen to assume that 40% (420,000 workers) may be exposed in a way that does not comply with best practice as a high estimate and 10% (105,000 workers exposed) is used as a low estimate. It is hoped that the true level of exposure in conditions not conforming to best practice is somewhere within this range, as the current level of risk management is across the EU relative to best practice is not known.

Based on the range in the number of workers potentially exposed and using Eurostat data on the number of enterprises, it is estimated that perhaps 20,000 to 80,000 enterprises (rounded figures) could be affected. This is set out below:

Table 4.1 Estimates of the number of enterprises affected

No: of employees bands	Average number of workers per class size (rounded)	Average composition of enterprises for all affected NACE sectors that use mineral oils*	Number of workers potentially exposed		Estimated number of enterprises affected by band size	
			Low	High	Low	High
Between 1 and 9	5	90%	94,752	379,007	18,950	75,801
Between 10 & 19	15	6%	6,335	25,340	422	1,689
Between 20 & 49	25	3%	3,084	12,337	123	493
Between 50 & 250	150	1%	773	3,093	5	21
Greater than 250	500	0%	56	223	0	0
Total	-	-	105,000	420,000	19,501	78,005

Notes:
* - The average composition of enterprises within each category is based on Eurostat data for NACE code sectors: 50.2, 50.4 and 37.2. It is not known whether more exposures occurs in one NACE sector over another and therefore no weightings have been used to determine the average number of workers per enterprise.
1) The figures in this table have not been rounded but are subject to significant uncertainty.

There are expected to be relatively low costs for enterprises to implement improved training, housekeeping, PPE, measures that are already considered to be 'best practice'. There may be some initial costs associated with familiarisation with the new requirements but in general it is assumed that costs will range between €100-500 per year per enterprise (including additional costs of equipment and the additional cost of time spent on e.g. cleaning, training and administration).

As illustrated in the Table 4.2, the total compliance cost over the assessment period is estimated to be between €2 and €39 million per year which is estimated to be around €50 to €900m in total over the period 2010-70 (in 2010 prices and discounted using a 4% discount rate).

Table 4.2 Estimated cost of compliance (2010 prices)

Number of enterprises affected		**Annual cost per enterprise (2010)**		**Total annual cost in millions (2010)**		**Total cost 2010-2070 in millions***	
Low	High	Low	High	Low	High	Low	High
19,501	78,005	€ 100	€ 500	€ 2	€ 39	€ 46	€ 918

*- Costs over time have been discounted using a 4% discount rate

The high costs reflect the large number of people potentially exposed (up to 1m workers) although the high cost estimate is expected to be a significant overestimate, as the current level of risk management is across the EU is not known and is likely to be higher than the 60% uptake assumed for the high estimate.

Potential for closure of companies

The cost of compliance per enterprise (€100-500) is not thought to be prohibitive for any enterprise size and therefore there is expected to be only limited potential risk of closure of companies.

Potential impacts for specific types of companies

The majority of the sector is made up of a large number of SMEs so compliance with 'best practice' is likely to be more difficult to enforce than in less dispersed industries, but the cost of compliance per enterprise (€100-500) is not thought to be prohibitive, even for most SMEs.

Administrative costs to employers and public authorities

The following table (Table 4.3) describes the administrative burden to employers by the substance being included on the Carcinogens Directive.

Table 4.3 Administrative burdens to employers

Type of administrative cost	Relevant article(s)	Type of cost	Significance
1. Familiarisation costs with the Directive and requirements for full compliance	-	Individual(s) responsible for health and safety and training will need to familiarise themselves with the requirements of the Directive. This is largely a one-off cost with some periodic costs for training of new trainers.	Low
2. Time for R&D and exploration of suitable alternatives to reduce and replace use of the substance so far as technically feasible 3. Document findings	4 – Reduction and replacement	Largely one-off cost but findings may need to be updated annually. Many large size firms are likely to already be investing in R&D and alternatives. As part of the CLP Regulation (EC) No 1272/2008 and Chemicals Agents Directive (CAD) risks must be eliminated or reduced to a minimum. Substitution is preferred and, if that isn't possible, there is a hierarchy of controls (e.g. workplace changes, general protective equipment, PPE, etc).	Low
4. Change in practice to use of closed systems when using the substance.	5 – Prevention and reduction of exposure	These costs are already estimated in the cost of compliance section. This will only affect those firms that do not have or use closed systems	Estimated elsewhere
5. Upon request, employers will need make information available to competent authorities on activities/processes carried out and why the substance is used, quantities used, number of workers exposed and protective measures and equipment used to reduce exposure	6 – Information for the competent authority	As this information is only required upon request (with the frequency of requests unknown), the administrative costs are likely to be low given much of this information should be readily available to the firms concerned.	Low

Type of administrative cost	Relevant article(s)	Type of cost	Significance
6. Develop/update health and safety and best practice guidance for: ○ Minimising use and exposure to workers to the substance ○ Redesign work processes and engineering controls to avoid/minimise release of carcinogens or mutagens ○ Hygiene measures, in particular regular cleaning of floors, walls and other surfaces ○ Information for workers ○ Warnings and safety signs ○ Drawing up plans to deal with emergencies likely to result in abnormally high exposure	5 – Prevention and reduction of exposure 7 – Unforeseen exposure 8 – Foreseeable exposure 9 – Access to risk areas 10 – Hygiene and individual protection	Some firms may only incur a one-off cost from updating existing guidance and training material. Some firms may need to redesign work practices to minimise exposure to workers and the number of workers exposed. The costs of implementing controls on exposure (such as LEV or PPE) are already estimated in the costs of compliance section. Firms should already be doing many of these good practices as part of the CLP Regulation and the CAD.	Low-Medium
7. Additional costs of training new and existing staff in line with requirements of the Directive 8. Additional costs of making information available to employees 9. Consultation with employees on compliance with the Directive	11 – Information and training of workers 12 – Information for workers 13 – Consultation and participation with workers	Largely one-off cost but training may need to be repeated periodically if necessary. Periodic training should typically be carried out as best practice so largely one-off cost of updating training material.	Low/medium
9. Record keeping for 40 years of list of workers engaged in activities where they are exposed to the substance and individual medical records when health surveillance is carried out.	15 – Record keeping Reference to 12(c) and 14(4)	Likely to be a small annual cost to ensure personnel files are kept up to date and information is correctly stored.	Low

Note: Readers should consult the Directive for the official wording around specific requirements. This table provides only a summary of what are perceived to be the most significant administrative requirements of the Directive. Grading of the significance of impacts is subjective and is based on professional judgement.

The following table (Table 4.4) describes the administrative burden to competent authorities by the substance being included on the Carcinogens Directive.

Table 4.4 Administrative burdens to Competent Authorities

Type of administrative cost	Relevant article(s)	Type of cost	Significance
1. Familiarisation costs with the Directive and requirements for full compliance	-	Individual(s) responsible will need to familiarise themselves with the requirements of the directive. This is largely a one-off cost with some periodic costs for new/replacement staff.	Low
2. Establishing, in accordance with national laws and/or practice, arrangements for carrying out relevant health surveillance of workers for whom the results of the assessment referred to in Article 3(2) reveal a risk to health or safety.	14 – Health Surveillance	The annual costs will depend on the number visits undertaken.	Low – High
3. Communication with the Commission on provisions in national law to enforce the Directive. 4. Time and costs of implementing Directive into national law (consultation process)	19 – Notifying the commission 20 – Repeal	Largely one-off cost of transposing the Directive into national law	Medium (one-off cost)

Note: Readers should consult the Directive for the official wording around specific requirements. This table provides only a summary of what are perceived to be the most significant administrative requirements of the Directive. Grading of the significance of impacts is subjective and is based on professional judgement.

Third countries

Given that the cost of compliance per enterprise (€100-500) is not thought to be prohibitive, there are not expected to be any significant impacts upon third countries compared to those that might occur under the baseline scenario.

4.2.2 Impact on innovation and research

It is possible that introducing measures at an EU-wide level to introduce best practice for used engine oil may stimulate further R&D in protective equipment and improvements in the safe use of mineral oils to minimise risks of dermal exposure.

However given that the industry is predominately made up of smaller companies and that the measures envisaged are fairly simple, it is considered likely that these companies would tend to adopt products and compliance techniques that are already being applied within other parts of the industry.

4.2.3 Macroeconomic impact

Whilst there is likely to be a significant investment in complying with the Directive if mineral oil is introduced – perhaps €50 to €900m over the period 2010-2070, associated with protective equipment, training and general best practice in reducing risks of dermal exposure – this is expected to have a negligible macroeconomic impact since costs will be spread all over the EU (maintenance and repair of vehicles is applicable to all Member States). These costs are negligible compared, for example, to the total value of goods and services in the manufacturing sector of €5 trillion in 2006 alone (i.e. a single year rather than a 60 year period).

With fewer life years lost and fewer cancer registrations, there should be a benefit to the economy through avoided loss of output and consumption in the future (post 2040), for example due to greater productivity from fewer sick days as well as greater consumption due to fewer premature deaths and greater taxes raised. However, this is very difficult to estimate with any level of accuracy.

4.3 SOCIAL IMPACTS

4.3.1 Employment and labour markets

There are not expected to be any noticeable changes to the numbers of workers required as a result of introducing an EU-wide biological monitoring value. However, job patterns may be altered as it is recognised that, in order to meet best practice, behavioural change amongst employees and updating health and safety training is expected to be required.

4.3.2 Changes in end products

There are not expected to be any noticeable changes to the end products since control measures do not change the characteristics of the ultimate function fulfilled (motor vehicle repaid). Furthermore, since there is not expected to be any closure of companies, there should not be any change in supply of products relative to the baseline scenario.

4.4 ENVIRONMENTAL IMPACTS

According to the Anglo-Welsh Environment Agency: “Oil is toxic and poisons wildlife. It forms a thin layer on the surface of water which stops oxygen getting into the water. Plants, animals and fish living in the water can be poisoned or suffocated”[13].

A closed collection system for used oil may prevent oil from entering drains and the waste-water system. However, since the proposed control measures to limit worker

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[13] Environment Agency Motor Vehicle Repair Factsheet available online here: http://publications.environment-agency.gov.uk/pdf/PMHO0406BKQX-e-e.pdf

exposure do not generally also target releases to the environment, there is not expected to be any *significant* change in environmental impacts relative to the baseline scenario.

5 COMPARISON OF OPTIONS

The main impacts discussed in more detail in section 4 are summarised in the tables below, which are broken down by the main types of impacts (health, economic, social, macroeconomic and environmental).

Table 5.1 Comparison of health impacts by scenario (Present Value – 2010 €m prices)

Baseline Scenario		Introduce 'best practice' control measures	
Health Costs	**Health Benefits**	**Health Costs**	**Health Benefits**
As set out in section 2.5, the health costs of cancer (NMSC) over the period 2010-70 are estimated to be: - Females: €140m to €900m - Males: €300m to €2bn - Total: €450m to €3bn This range takes into consideration tangible costs (e.g. lost income, lost output from reduced productivity, medical costs, life years lost) and intangible costs (e.g. emotional and physical suffering from having cancer).	There are note expected to be any health benefits over time as it is assumed that the number of cancer registrations increase over time.	None - there is expected to be a cost saving from avoided health care and reduced cost of illness due to reductions in cancer registrations. This has been estimated as a benefit.	Whilst full compliance with best practice is unlikely to significantly alter health costs under the baseline due to past exposure (e.g. costs up to 2030-2040), compliance with good practice could avoid the health costs associated with future exposure. Therefore a tentative and broad estimate of health benefits could be the total avoided costs associated with getting cancer post 2040 (i.e. avoided future exposure), which is estimated to be around €0.3-1.6bn (see table Table 2.9).

Note: Costs and benefits under the intervention options are relative to the baseline scenario (i.e. are not absolute impacts but differences)

Table 5.2 Comparison of economic impacts by scenario (Present Value – 2010 €m prices)

Baseline Scenario		Introduce 'best practice' control measures	
Economic Costs	**Economic Benefits**	**Economic Costs**	**Economic Benefits**
In the analysis presented, a static baseline is assumed. Therefore, no firms will incur costs to reduce exposure under the baseline scenario.	-	It is estimated that between 20,000 and 80,000 enterprises could be affected. There are expected to be relatively low costs for enterprises to implement improved training, housekeeping, PPE , measures that are already considered to be 'best practice'. There may be some initial costs associated with familiarisation with the new requirements but in general it is assumed that costs will range between €100-500 per year per enterprise (including costs of equipment and the cost of time spent on e.g. additional cleaning and administration). As illustrated in Table 4.2, the total compliance cost over the assessment period is estimated to be between €2 and €40 million per year which is estimated to be around €50 to €900m in total over the period 2010-70 (in 2010 prices and discounted using a 4% discount rate).	Having more consistent EU-wide controls should remove any EU competitive distortions between EU Member States with different limits.

Note: Costs and benefits under the intervention options are relative to the baseline scenario (i.e. are not absolute impacts but differences)

Table 5.3 Comparison of social impacts by scenario (Present Value – 2010 €m prices)

Baseline Scenario		Introduce 'best practice' control measures	
Social Costs	**Social Benefits**	**Social Costs**	**Social Benefits**
There are not expected to be any noticeable social impacts under the baseline scenario at an EU level.		Impacts are expected to be similar to the baseline. It is estimated that between 20,000 and 80,000 enterprises would need to make changes to workplace best practice.	

Note: Costs and benefits under the intervention options are relative to the baseline scenario (i.e. are not absolute impacts but differences)

Table 5.4 Comparison of macro-economic impacts by scenario (Present Value – 2010 €m prices)

Baseline Scenario		Introduce 'best practice' control measures	
Marco-economic Costs	**Marco-economic Benefits**	**Marco-economic Costs**	**Marco-economic Benefits**
There are not expected to be any noticeable macroeconomic impacts under the baseline scenario.		Negligible - since no additional engineering controls are expected to be required, there are not expected to be any significant macroeconomic impacts relative to the baseline scenario from introducing EU-wide controls to comply with the Directive.	

Note: Costs and benefits under the intervention options are relative to the baseline scenario (i.e. are not absolute impacts but differences)

Table 5.5 Comparison of environmental impacts by scenario (Present Value – 2010 €m prices)

Baseline Scenario		Introduce 'best practice' control measures	
Environmental Costs	**Environmental Benefits**	**Environmental Costs**	**Environmental Benefits**
No significant change expected.		However, since the proposed control measures to limit worker exposure do not generally also target releases to the environment, there is not expected to be any *significant* change in environmental impacts relative to the baseline scenario.	

Note: Costs and benefits under the intervention options are relative to the baseline scenario (i.e. are not absolute impacts but differences)

6 CONCLUSIONS

Mineral oils as used engine oils are not specifically classified IARC, although unrefined mineral oils are classified as a human carcinogen (category 1) and cause NMSC. Used engine oils are not classified in Europe under the classification and labelling regulations and so they are not currently within the scope of the Directive.

The main potential hazardous exposure arises from skin contact and so it is inappropriate to consider setting an inhalation Occupational Exposure Limit. A biological monitoring limit value is also impractical and inappropriate. We therefore consider that the best approach to control the risk from used engine oils would be through the application of best practice in preventative work practices and personal protective equipment.

Non-melanoma skin cancer is a very common malignancy in the EU with perhaps 500k cases arising each year. There is a high survival rate and treatment is straightforward and so the health costs are lower than for other types of cancer.

Exposure is most likely amongst people employed in motor vehicle maintenance and recycling of non-metal scrap, although we do not have reliable information about the prevalence of exposure. It is estimated that at most there could be 1 million people exposed in the EU. There is no information about the magnitude of exposure or about how this may have changed in recent years.

The predicted number of deaths in 2010 from past occupational exposure to used engine oil is 7, from about 916 incident cases. Over the period until 2060 the annual incidence is expected to rise to about 3,554 cases and 36 deaths as a consequence of demographic changes and increased employment in the relevant industry sectors. These data are likely to overestimate the health impact because we have had to used data on employment within the relevant sectors rather than exposure to used engine oil and because we have been unable to take account of improvements in controls in recent years.

The health costs over the next 60 years if no action is taken are estimated to be between about €445m and €2,815m. The appropriate policy intervention concerns ensuring that best practice is used in handling used engine oil, e.g. good personal hygiene and use of personal protective equipment. In our analysis we assumed that between 10% and 40% of employees are currently being exposed to oil in a way that does not conform with best practice; involving between about 20,000 and 78,000 workplaces. The total estimated cost of introducing best practice over the next 60 years is judged to be between about €46m and €920m.

It are not expected that there will be any important social, macro-economic or environmental impacts.

We consider that it would be prudent to undertake measurements of dermal exposure to used engine oil to assess the extent of exposure, both in situations that are poorly controlled and perhaps representative of historic exposure, and in situations where good practice is in place. This would help inform any regulatory action.

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8 APPENDIX

8.1 ESTIMATED NUMBER OF EMPLOYEES IN EACH INDUSTRY GROUP – MEMBER STATE BREAKDOWN – MALES AND FEMALES

Table 8.1.1 Number of workers exposed to Mineral Oils by Member State and NACE code – males and females

	NACE CODE											
		50.2			**50.4**			**37.2**			**Total**	
	Total	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
Austria	19778	12262	7515	1238	767	470	502	407	95	21517	13436	8081
Belgium	12610	9457	3152	1072	804	268	1856	1504	353	15538	11765	3773
Bulgaria	8097	7287	810	166	150	17	346	180	166	8609	7617	993
Cyprus	3653	2959	694	150	122	29	73	55	18	3877	3136	741
Czech Republic	32445	22712	9734	254	178	76	1714	1114	600	34414	24004	10410
Denmark	13093	10213	2880	531	415	117		Not Available		13625	10628	2997
Estonia	2340	1474	866	47	30	17	260	143	117	2646	1646	1000
Finland	8683	5557	3126	651	417	234	118	87	31	9452	6061	3391
France	73053	51137	21916	9714	6800	2914	11652	8972	2680	94419	66909	27510
Germany	132688	82267	50422	11405	7071	4334	9375	7219	2156	153469	96557	56912
Greece	19597	15481	4115	4018	3174	844	0	0	0	23615	18656	4959
Hungary	16843	6063	10780	977	352	626	800	504	296	18620	6919	11701
Ireland	5278	4170	1108	165	130	35	203	153	51	5646	4452	1194
Italy	147983	110987	36996	13536	10152	3384	7839	5879	1960	169358	127018	42339
Latvia	5601	2744	2856	139	68	71	101	59	43	5841	2871	2970
Lithuania	8924	5533	3391	72	44	27	382	199	183	9377	5776	3601
Luxembourg	444	333	111	37	28	9	81	70	10	561	430	131
Netherlands	15541	11034	4507	2370	1683	687	1767	1449	318	19678	14166	5512
Poland	80649	55648	25001	1074	741	333	5305	3555	1751	87028	59943	27085
Portugal	30511	14340	16171	3004	1412	1592	1103	651	452	34617	16402	18215
Romania	27941	18720	9220	216	145	71	2065	1115	950	30222	19980	10242
Slovakia	3048	2042	1006	39	26	13	554	354	199	3641	2423	1218
Slovenia	4768	2956	1812	126	78	48	295	195	100	5189	3229	1960

	NACE CODE											
	50.2			50.4			37.2			Total		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
Spain	107060	78154	28906	8163	5959	2204	2772	2162	610	117995	86275	31720
Sweden	17502	14002	3500	1794	1435	359	680	530	150	19976	15967	4009
United Kingdom	126173	90844	35328	7705	5548	2157	7319	5928	1391	141197	102320	38876
Total	**924299**	**595915**	**328384**	**68663**	**44077**	**24586**	**57162**	**40608**	**16555**	**1050124**	**728586**	**321540**

8.2 ESTIMATED DEATHS AND REGISTRATIONS IN THE EU FROM NMSC

Table 8.2.1 Forecast number of NMSC in ages 25+ (ages 15+ for NMSC registrations), based on projected EU country populations

NMSC deaths	*MEN*						*WOMEN*					
FTY	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Austria	42	54	70	89	110	109	33	36	45	55	66	66
Belgium	59	71	89	112	128	134	43	49	57	70	79	81
Bulgaria	37	39	46	54	62	74	26	29	34	39	42	47
Cyprus	3	5	7	9	11	14	2	3	4	5	6	8
Czech Republic	43	55	79	93	108	135	34	40	53	61	66	80
Denmark	27	35	48	54	62	62	19	22	29	33	37	38
Estonia	5	6	7	8	10	12	5	6	7	8	8	9
Finland	27	36	50	58	60	62	21	25	33	37	38	38
France	347	423	550	674	750	792	260	299	360	444	486	493
Germany (including ex-GDR from 1991)	464	654	745	921	1079	996	356	424	465	548	631	579
Greece	70	87	99	121	147	165	41	54	60	71	83	89
Hungary	42	49	62	76	88	112	37	43	50	59	61	72
Ireland	16	23	33	44	57	74	11	14	19	25	32	41
Italy	380	479	569	680	833	877	280	332	376	435	518	543
Latvia	8	10	11	14	17	20	9	10	11	12	14	14

NMSC deaths FTY	MEN 2010	2020	2030	2040	2050	2060	WOMEN 2010	2020	2030	2040	2050	2060
Lithuania	12	14	17	22	27	30	12	14	16	19	22	22
Luxembourg	2	3	4	5	7	7	2	2	2	3	4	4
Malta	2	2	4	4	5	5	1	2	2	3	3	3
Netherlands	76	102	144	175	197	190	54	64	86	105	118	114
Poland	140	177	241	327	350	429	118	145	181	238	243	276
Portugal	57	71	85	106	129	150	40	50	59	70	82	91
Romania	87	103	122	158	193	237	61	74	85	107	124	145
Slovakia	17	21	30	42	50	63	14	17	23	30	34	40
Slovenia	9	12	16	21	24	27	7	9	11	13	15	15
Spain	254	313	391	511	665	784	176	210	252	319	398	453
Sweden	56	67	90	100	113	121	37	41	52	58	64	69
United Kingdom	332	408	519	615	722	761	222	244	301	358	425	447
European Union (27 countries)	2614	3318	4128	5095	6003	6442	1921	2258	2670	3225	3696	3876

NMSC registrations FTY	MEN 2010	2020	2030	2040	2050	2060	WOMEN 2010	2020	2030	2040	2050	2060
Austria	5378	6632	8027	9370	10205	10262	4822	5394	6226	7050	7617	7563
Belgium	7197	8492	10119	11576	12378	12848	6189	6885	7799	8775	9301	9486
Bulgaria	4880	5088	5598	6132	6653	6960	4360	4603	4936	5156	5279	5326
Cyprus	437	589	771	964	1160	1376	341	445	574	707	832	956
Czech Republic	6048	7522	9136	10267	11439	12324	5562	6399	7418	7985	8433	8950
Denmark	3587	4400	5179	5586	5841	5925	2890	3314	3841	4146	4333	4376
Estonia	676	747	848	973	1088	1196	828	888	935	992	1016	1031
Finland	3514	4436	5271	5585	5665	5847	3121	3607	4143	4383	4347	4340
France	40923	49117	58806	66292	70526	73575	36004	40981	47066	52777	55131	55647

NMSC registrations	*MEN*						*WOMEN*					
FTY	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Germany (including ex-GDR from 1991)	60375	73298	82922	92694	95729	90941	51897	57775	62331	67369	69161	65001
Greece	8337	9596	10964	12728	14122	14535	6532	7552	8282	9192	9845	9923
Hungary	5632	6401	7408	8424	9484	10429	5854	6419	7024	7487	7766	8156
Ireland	2227	2999	3937	4962	6051	6963	1776	2268	2898	3582	4256	4855
Italy	45165	53152	61403	70260	76854	76920	39101	44158	48945	54105	58168	57726
Latvia	1142	1252	1404	1617	1810	1963	1401	1467	1521	1614	1665	1674
Lithuania	1657	1851	2141	2530	2839	3037	1928	2096	2260	2478	2579	2536
Luxembourg	285	369	471	577	655	702	239	284	344	417	474	508
Malta	249	323	399	442	472	516	207	254	300	328	339	359
Netherlands	10264	13054	15956	17694	18242	18022	8474	9929	11753	13034	13473	13167
Poland	19509	23982	29541	34284	37340	41016	19367	22584	26357	29625	30416	31792
Portugal	7066	8305	9774	11458	12904	13731	6182	7162	8092	9089	9855	10186
Romania	11878	13283	15405	18110	20686	22256	10646	11843	13214	14797	15987	16674
Slovakia	2505	3144	4022	4827	5476	6020	2507	2967	3566	4086	4378	4628
Slovenia	1219	1569	1921	2219	2352	2379	1152	1323	1482	1642	1693	1666
Spain	30287	36864	45495	56019	65008	67945	25602	30264	35625	41890	47007	48674
Sweden	6694	7970	9324	10084	10854	11490	5302	5898	6759	7276	7718	8066
United Kingdom	40408	47829	56113	63240	69491	74687	32887	36440	41936	47172	51754	54557
European Union (27 countries)	327539	392263	462355	528914	575324	593864	285172	323199	365627	407153	432824	437825

8.3 SUPPLEMENTARY TABLES – HEALTH DATA UNDER THE BASELINE SCENARIO

Table 8.3.1 Numbers and proportions of the population ever exposed for the baseline scenario by country, men plus women

Scenario	**Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.**					
Country	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Number ever exposed in the REP						
Austria	64,525	77,359	95,493	113,802	126,948	135,070
Belgium	45,874	54,000	65,430	76,783	84,922	89,942
Bulgaria	23,678	28,261	34,707	41,169	45,792	48,637
Cyprus	10,853	13,024	16,083	19,166	21,375	22,736
Czech Republic	101,690	121,214	148,751	176,406	196,245	208,488
Denmark	38,292	46,128	57,184	68,359	76,368	81,305
Estonia	8,201	9,676	11,754	13,826	15,313	16,232
Finland	28,081	33,733	41,720	49,792	55,587	59,166
France	293,971	340,686	407,416	475,148	522,910	552,799
Germany	465,513	554,075	679,091	804,626	894,766	950,454
Greece	66,120	79,652	98,742	118,037	131,863	140,384
Hungary	61,338	73,229	90,072	107,072	119,313	126,899
Ireland	16,029	19,168	23,590	28,037	31,224	33,188
Italy	489,557	584,209	717,638	851,669	947,757	1,007,013
Latvia	18,329	21,987	27,166	32,403	36,170	38,501
Lithuania	28,472	33,986	41,774	49,610	55,237	58,714
Luxembourg	1,659	1,945	2,348	2,747	3,033	3,209
Malta	0	0	0	0	0	0
Netherlands	58,285	69,009	84,118	99,209	110,033	116,712
Poland	258,972	308,034	377,220	446,595	496,369	527,090
Portugal	109,874	131,429	161,933	192,732	214,883	228,594
Romania	91,329	108,389	132,442	156,524	173,806	184,476
Slovakia	11,313	13,215	15,890	18,531	20,426	21,596
Slovenia	15,788	18,796	23,041	27,305	30,367	32,258
Spain	336,077	405,162	502,651	601,232	672,003	715,760
Sweden	56,422	67,503	83,118	98,823	110,075	117,008
United Kingdom	425,465	500,612	606,697	713,985	790,916	838,359
TOTAL	3,125,708	3,714,482	4,546,071	5,383,591	5,983,701	6,354,589

Scenario Country	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter. 2010	2020	2030	2040	2050	2060
Proportion of the population exposed						
Austria	1.05%	1.19%	1.41%	1.64%	1.82%	1.96%
Belgium	0.60%	0.66%	0.77%	0.87%	0.95%	1.00%
Bulgaria	0.42%	0.51%	0.67%	0.83%	0.98%	1.13%
Cyprus	1.94%	1.92%	2.09%	2.25%	2.30%	2.31%
Czech Republic	1.33%	1.51%	1.86%	2.22%	2.52%	2.79%
Denmark	1.00%	1.15%	1.37%	1.62%	1.80%	1.89%
Estonia	0.87%	1.01%	1.27%	1.51%	1.71%	1.89%
Finland	0.74%	0.85%	1.03%	1.23%	1.39%	1.49%
France	0.68%	0.74%	0.85%	0.95%	1.03%	1.07%
Germany	0.75%	0.88%	1.08%	1.32%	1.53%	1.71%
Greece	0.78%	0.91%	1.12%	1.31%	1.48%	1.63%
Hungary	0.84%	0.99%	1.23%	1.48%	1.69%	1.87%
Ireland	0.53%	0.53%	0.59%	0.64%	0.67%	0.69%
Italy	1.07%	1.23%	1.49%	1.74%	1.96%	2.15%
Latvia	1.14%	1.35%	1.77%	2.18%	2.55%	2.91%
Lithuania	1.22%	1.41%	1.79%	2.20%	2.56%	2.92%
Luxembourg	0.48%	0.50%	0.54%	0.58%	0.60%	0.60%
Malta	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Netherlands	0.50%	0.56%	0.66%	0.78%	0.88%	0.94%
Poland	0.96%	1.08%	1.33%	1.61%	1.86%	2.11%
Portugal	1.39%	1.58%	1.88%	2.17%	2.42%	2.61%
Romania	0.60%	0.69%	0.86%	1.04%	1.20%	1.37%
Slovakia	0.30%	0.32%	0.39%	0.46%	0.52%	0.59%
Slovenia	1.04%	1.19%	1.48%	1.78%	2.06%	2.33%
Spain	0.97%	1.07%	1.27%	1.46%	1.63%	1.78%
Sweden	0.86%	0.95%	1.14%	1.31%	1.42%	1.48%
United Kingdom	0.99%	1.08%	1.24%	1.39%	1.47%	1.51%
TOTAL	0.87%	0.98%	1.17%	1.37%	1.53%	1.65%

Table 8.3.2 Results for the baseline scenario for NMSC, by country, men plus women

Scenario	**Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.**					
Country	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Attributable Fraction						
Austria	0.19%	0.21%	0.25%	0.31%	0.37%	0.41%
Belgium	0.10%	0.11%	0.13%	0.16%	0.18%	0.20%
Bulgaria	0.08%	0.10%	0.13%	0.18%	0.22%	0.27%
Cyprus	0.40%	0.38%	0.43%	0.48%	0.52%	0.54%
Czech Republic	0.24%	0.26%	0.34%	0.43%	0.52%	0.60%
Denmark	0.20%	0.22%	0.28%	0.34%	0.40%	0.44%
Estonia	0.14%	0.16%	0.21%	0.27%	0.32%	0.37%
Finland	0.14%	0.15%	0.19%	0.24%	0.29%	0.32%
France	0.11%	0.12%	0.14%	0.17%	0.20%	0.22%
Germany	0.13%	0.15%	0.19%	0.24%	0.30%	0.35%
Greece	0.16%	0.18%	0.23%	0.28%	0.34%	0.39%
Hungary	0.14%	0.16%	0.20%	0.25%	0.30%	0.34%
Ireland	0.10%	0.10%	0.12%	0.13%	0.15%	0.16%
Italy	0.20%	0.22%	0.28%	0.35%	0.42%	0.47%
Latvia	0.20%	0.23%	0.31%	0.40%	0.49%	0.58%
Lithuania	0.21%	0.24%	0.32%	0.41%	0.51%	0.61%
Luxembourg	0.08%	0.08%	0.09%	0.11%	0.12%	0.13%
Malta	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Netherlands	0.09%	0.10%	0.12%	0.15%	0.18%	0.20%
Poland	0.17%	0.18%	0.24%	0.31%	0.38%	0.45%
Portugal	0.23%	0.26%	0.31%	0.38%	0.45%	0.50%
Romania	0.10%	0.12%	0.15%	0.19%	0.24%	0.28%
Slovakia	0.04%	0.05%	0.06%	0.08%	0.10%	0.11%
Slovenia	0.18%	0.20%	0.26%	0.33%	0.41%	0.48%
Spain	0.18%	0.20%	0.24%	0.29%	0.35%	0.40%
Sweden	0.17%	0.18%	0.22%	0.27%	0.31%	0.34%
United Kingdom	0.18%	0.19%	0.23%	0.28%	0.31%	0.33%
TOTAL	0.15%	0.17%	0.21%	0.26%	0.31%	0.35%

Scenario	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.					
Country	2010	2020	2030	2040	2050	2060
Attributable Deaths						
Austria	0	0	0	0	1	1
Belgium	0	0	0	0	0	0
Bulgaria	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0
Czech Republic	0	0	0	1	1	1
Denmark	0	0	0	0	0	0
Estonia	0	0	0	0	0	0
Finland	0	0	0	0	0	0
France	1	1	1	2	2	3
Germany	1	2	2	4	5	6
Greece	0	0	0	1	1	1
Hungary	0	0	0	0	0	1
Ireland	0	0	0	0	0	0
Italy	1	2	3	4	6	7
Latvia	0	0	0	0	0	0
Lithuania	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Netherlands	0	0	0	0	1	1
Poland	0	1	1	2	2	3
Portugal	0	0	0	1	1	1
Romania	0	0	0	1	1	1
Slovakia	0	0	0	0	0	0
Slovenia	0	0	0	0	0	0
Spain	1	1	2	2	4	5
Sweden	0	0	0	0	1	1
United Kingdom	1	1	2	3	4	4
TOTAL	7	9	14	22	30	36

Scenario	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.					
Country	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Attributable Registrations						
Austria	19	25	36	51	65	72
Belgium	13	16	23	32	40	45
Bulgaria	7	9	13	19	25	31
Cyprus	3	4	5	8	10	12
Czech Republic	27	36	55	76	101	124
Denmark	12	17	24	32	39	43
Estonia	2	3	4	5	7	8
Finland	9	12	18	24	28	32
France	80	104	148	202	247	276
Germany	144	192	272	388	492	541
Greece	23	29	41	59	77	90
Hungary	16	21	30	42	54	65
Ireland	4	5	8	11	15	18
Italy	161	210	298	418	545	616
Latvia	5	6	9	13	17	21
Lithuania	8	9	14	20	27	33
Luxembourg	0	1	1	1	1	1
Malta	0	0	0	0	0	0
Netherlands	16	21	32	44	55	60
Poland	64	84	130	191	251	318
Portugal	32	41	57	80	104	122
Romania	23	29	43	63	87	109
Slovakia	2	3	5	7	9	12
Slovenia	4	6	9	13	16	19
Spain	100	128	190	279	379	448
Sweden	19	24	34	45	56	64
United Kingdom	125	155	219	295	366	415
TOTAL	916	1,188	1,717	2,415	3,095	3,554

Scenario Country	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter. 2010	2020	2030	2040	2050	2060
Attributable Years of Life Lost (YLLs)						
Austria	1	2	3	4	6	6
Belgium	1	1	2	3	3	4
Bulgaria	0	1	1	1	2	2
Cyprus	0	0	0	1	1	1
Czech Republic	2	2	4	5	7	9
Denmark	1	1	2	2	3	3
Estonia	0	0	0	0	0	1
Finland	1	1	1	2	2	3
France	7	9	13	19	24	27
Germany	11	16	22	33	45	49
Greece	2	2	3	5	6	8
Hungary	1	1	2	3	4	5
Ireland	0	0	1	1	1	2
Italy	14	18	26	37	51	59
Latvia	0	0	1	1	1	1
Lithuania	0	1	1	1	2	2
Luxembourg	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Netherlands	1	2	2	4	5	5
Poland	4	6	9	14	18	25
Portugal	2	3	4	6	8	10
Romania	1	2	3	4	6	7
Slovakia	0	0	0	0	1	1
Slovenia	0	0	1	1	1	2
Spain	9	11	16	24	35	44
Sweden	2	2	3	4	5	6
United Kingdom	10	13	18	25	33	37
TOTAL	71	94	138	202	268	315

Scenario Country	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter. 2010	2020	2030	2040	2050	2060
Attributable Years of Life Lived with Disability (DALYs)						
Austria	2	2	4	5	7	8
Belgium	1	2	2	3	4	5
Bulgaria	1	1	1	2	2	3
Cyprus	0	0	1	1	1	1
Czech Republic	2	3	5	7	9	12
Denmark	1	2	2	3	4	5
Estonia	0	0	0	0	1	1
Finland	1	1	2	3	3	4
France	9	12	17	24	30	33
Germany	15	20	29	42	56	61
Greece	2	3	4	6	8	10
Hungary	1	2	3	4	5	6
Ireland	0	1	1	1	2	2
Italy	17	23	33	47	63	73
Latvia	0	1	1	1	2	2
Lithuania	1	1	1	2	2	3
Luxembourg	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Netherlands	2	2	3	5	6	6
Poland	6	8	12	19	24	32
Portugal	3	4	6	8	11	13
Romania	2	2	4	5	8	10
Slovakia	0	0	0	1	1	1
Slovenia	0	1	1	1	2	2
Spain	11	14	21	31	44	55
Sweden	2	3	4	5	6	7
United Kingdom	13	16	23	32	41	46
TOTAL	93	122	179	258	341	398

Table 8.3.3 Numbers and proportions of the EU population ever exposed, by industry, men plus women

Scenario	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.					
Industry sector	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Number ever exposed in the REP						
Maintenance and Repair of Motor Vehicles	2,685,518	3,234,322	4,009,558	4,794,018	5,356,822	5,704,192
Sales, maintenance and repair of motorcycles and related parts and accessories	199,174	239,879	297,375	355,553	397,290	423,049
Recycling of non-metal waste and scrap	241,017	240,281	239,138	234,020	229,589	227,348

Scenario	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.					
Industry sector	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Proportion of the population exposed						
Maintenance and Repair of Motor Vehicles	0.743%	0.850%	1.031%	1.217%	1.367%	1.485%
Sales, maintenance and repair of motorcycles and related parts and accessories	0.055%	0.063%	0.076%	0.090%	0.101%	0.110%
Recycling of non-metal waste and scrap	0.067%	0.063%	0.062%	0.059%	0.059%	0.059%

Table 8.3.4 Occupation attributable fractions, deaths, registrations, YLLs and DALYs for NMSC by industry, men plus women

Scenario	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.					
Industry sector	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Attributable Fraction						
Maintenance and Repair of Motor Vehicles	0.14%	0.16%	0.20%	0.25%	0.29%	0.33%
Sales, maintenance and repair of motorcycles and related parts and accessories	0.01%	0.01%	0.01%	0.02%	0.02%	0.02%
Recycling of non-metal waste and scrap	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Scenario	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter.					
Industry sector	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Attributable Deaths						
Maintenance and Repair of Motor Vehicles	6	9	13	20	28	34
Sales, maintenance and repair of motorcycles and related parts and accessories	0	1	1	2	2	3
Recycling of non-metal waste and scrap	0	0	0	0	0	0

Scenario Industry sector	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter. 2010	2020	2030	2040	2050	2060
Attributable Registrations						
Maintenance and Repair of Motor Vehicles	853	1,106	1,599	2,248	2,881	3,308
Sales, maintenance and repair of motorcycles and related parts and accessories	63	82	119	167	214	246
Recycling of non-metal waste and scrap	0	0	0	0	0	0

Scenario Industry sector	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter. 2010	2020	2030	2040	2050	2060
Attributable Years of Life Lost (YLLs)						
Maintenance and Repair of Motor Vehicles	66	88	129	188	250	293
Sales, maintenance and repair of motorcycles and related parts and accessories	5	7	10	14	19	22
Recycling of non-metal waste and scrap	0	0	0	0	0	0

Scenario Industry sector	Baseline (trend) scenario (1) - Linear employment and exposure level trends assumed to 2021-30, constant thereafter. 2010	2020	2030	2040	2050	2060
Attributable Years of Life Lived with Disability (DALYs)						
Maintenance and Repair of Motor Vehicles	86	113	166	241	317	371
Sales, maintenance and repair of motorcycles and related parts and accessories	6	8	12	18	24	28
Recycling of non-metal waste and scrap	0	0	0	0	0	0

8.4 SUPPLEMENTARY TABLES - COSTS UNDER THE BASELINE SCENARIO

Table 8.4.1 Health costs – baseline scenario – Member State breakdown - Based on a 4% discount rate

Low	Female	Male	Total	High	Female	Male	Total
Austria	€ 3	€ 6	€ 9	Austria	€ 23	€ 36	€ 58
Belgium	€ 1	€ 4	€ 6	Belgium	€ 10	€ 28	€ 37
Bulgaria	€ 0	€ 3	€ 3	Bulgaria	€ 2	€ 20	€ 22
Czech Republic	€ 4	€ 6	€ 13	Czech Republic	€ 27	€ 61	€ 88
Cyprus	€ 0	€ 2	€ 1	Cyprus	€ 2	€ 7	€ 9
Denmark	€ 1	€ 4	€ 6	Denmark	€ 8	€ 29	€ 37
Estonia	€ 0	€ 0	€ 1	Estonia	€ 3	€ 4	€ 6
Finland	€ 2	€ 3	€ 4	Finland	€ 10	€ 17	€ 27
France	€ 12	€ 27	€ 40	France	€ 74	€ 162	€ 236
Germany	€ 26	€ 45	€ 71	Germany	€ 169	€ 274	€ 444
Greece	€ 2	€ 9	€ 11	Greece	€ 14	€ 55	€ 69
Hungary	€ 5	€ 2	€ 7	Hungary	€ 32	€ 16	€ 48
Ireland	€ 0	€ 2	€ 2	Ireland	€ 3	€ 10	€ 13
Italy	€ 21	€ 60	€ 81	Italy	€ 128	€ 365	€ 493
Latvia	€ 1	€ 1	€ 2	Latvia	€ 8	€ 7	€ 15
Lithuania	€ 1	€ 2	€ 3	Lithuania	€ 10	€ 14	€ 23
Luxembourg	€ 0	€ 0	€ 0	Luxembourg	€ 0	€ 1	€ 1
Malta	€ 0	€ 0	€ 0	Malta	€ 0	€ 0	€ 0
Netherlands	€ 2	€ 5	€ 8	Netherlands	€ 15	€ 35	€ 50
Poland	€ 10	€ 22	€ 32	Poland	€ 72	€ 145	€ 217
Portugal	€ 8	€ 7	€ 14	Portugal	€ 51	€ 43	€ 94
Romania	€ 3	€ 7	€ 10	Romania	€ 25	€ 48	€ 73
Slovakia	€ 0	€ 1	€ 1	Slovakia	€ 3	€ 5	€ 8
Slovenia	€ 1	€ 1	€ 2	Slovenia	€ 6	€ 9	€ 14
Spain	€ 14	€ 40	€ 54	Spain	€ 91	€ 238	€ 328
Sweden	€ 2	€ 7	€ 9	Sweden	€ 11	€ 43	€ 54
United Kingdom	€ 15	€ 41	€ 56	United Kingdom	€ 98	€ 251	€ 349
TOTAL	€ 136	€ 307	€ 445	**TOTAL**	€ 894	€ 1,920	€ 2,815

Table 8.4.2 Health costs - baseline scenario - Industry group breakdown - Based on a 4% discount rate

Low	**Female**	**Male**	**Total**
Maintenance and Repair of Motor Vehicles	€ 126	€ 286	€ 362
Sales, maintenance and repair of motorcycles and related parts and accessories	€ 9	€ 21	€ 27
TOTAL	€ 135	€ 307	€ 389
High			
Maintenance and Repair of Motor Vehicles	€ 829	€ 1,779	€ 2,278
Sales, maintenance and repair of motorcycles and related parts and accessories	€ 61	€ 133	€ 169
TOTAL	€ 890	€ 1,912	€ 2,447

Table 8.4.3 Health costs – baseline scenario – Member State breakdown - Based on a declining discount rate

Low	**Female**	**Male**	**Total**	**High**	**Female**	**Male**	**Total**
Austria	€ 5	€ 8	€ 12	Austria	€ 31	€ 49	€ 79
Belgium	€ 2	€ 6	€ 8	Belgium	€ 13	€ 37	€ 50
Bulgaria	€ 0	€ 4	€ 4	Bulgaria	€ 3	€ 27	€ 30
Czech Republic	€ 5	€ 8	€ 17	Czech Republic	€ 37	€ 84	€ 121
Cyprus	€ 0	€ 3	€ 2	Cyprus	€ 2	€ 10	€ 12
Denmark	€ 2	€ 6	€ 8	Denmark	€ 11	€ 38	€ 50
Estonia	€ 0	€ 1	€ 1	Estonia	€ 3	€ 5	€ 8
Finland	€ 2	€ 4	€ 6	Finland	€ 14	€ 23	€ 36
France	€ 16	€ 37	€ 54	France	€ 99	€ 219	€ 318
Germany	€ 35	€ 62	€ 97	Germany	€ 229	€ 374	€ 603
Greece	€ 3	€ 12	€ 15	Greece	€ 19	€ 75	€ 94
Hungary	€ 6	€ 3	€ 9	Hungary	€ 44	€ 22	€ 66
Ireland	€ 1	€ 2	€ 3	Ireland	€ 4	€ 14	€ 18
Italy	€ 28	€ 82	€ 110	Italy	€ 173	€ 498	€ 671
Latvia	€ 2	€ 1	€ 3	Latvia	€ 11	€ 9	€ 21
Lithuania	€ 2	€ 3	€ 4	Lithuania	€ 13	€ 19	€ 32
Luxembourg	€ 0	€ 0	€ 0	Luxembourg	€ 0	€ 1	€ 2
Malta	€ 0	€ 0	€ 0	Malta	€ 0	€ 0	€ 0
Netherlands	€ 3	€ 7	€ 10	Netherlands	€ 20	€ 48	€ 67
Poland	€ 14	€ 30	€ 44	Poland	€ 99	€ 202	€ 300
Portugal	€ 10	€ 9	€ 19	Portugal	€ 69	€ 59	€ 128
Romania	€ 4	€ 9	€ 14	Romania	€ 34	€ 66	€ 101
Slovakia	€ 1	€ 1	€ 2	Slovakia	€ 4	€ 7	€ 11
Slovenia	€ 1	€ 2	€ 3	Slovenia	€ 8	€ 12	€ 19
Spain	€ 20	€ 55	€ 75	Spain	€ 124	€ 328	€ 452
Sweden	€ 2	€ 9	€ 12	Sweden	€ 15	€ 58	€ 72
United Kingdom	€ 20	€ 55	€ 75	United Kingdom	€ 132	€ 338	€ 470
TOTAL	€ 185	€ 421	€ 608	**TOTAL**	€ 1,211	€ 2,621	€ 3,832

Table 8.4.4 Health costs – baseline scenario – Industry Group breakdown – Based on a declining discount rate

Low	Female	Male	Total
Maintenance and Repair of Motor Vehicles	€ 172	€ 391	€ 563
Sales, maintenance and repair of motorcycles and related parts and accessories	€ 13	€ 29	€ 42
TOTAL	€ 184	€ 421	€ 605
High			
Maintenance and Repair of Motor Vehicles	€ 1,123	€ 2,427	€ 3,219
Sales, maintenance and repair of motorcycles and related parts and accessories	€ 82	€ 181	€ 239
TOTAL	€ 1,205	€ 2,608	€ 3,458

Table 8.4.5 Summary

Costs by Gender (€m)	2010-2019	2020-2029	2030-2039	2040-2049	2050-2059	2060-2069
Female	17 to 120	18 to 124	27 to 184	35 to 233	42 to 270	44 to 280
Male	37 to 236	40 to 256	62 to 393	81 to 507	97 to 598	103 to 630
Total	54 to 356	59 to 381	90 to 577	117 to 740	140 to 868	148 to 910

Table 8.4.6 Health costs – baseline scenario – Member State breakdown - Based on a no discounting

Low	Female	Male	Total	High	Female	Male	Total
Austria	€ 15	€ 25	€ 40	Austria	€ 97	€ 157	€ 254
Belgium	€ 6	€ 19	€ 25	Belgium	€ 41	€ 119	€ 160
Bulgaria	€ 1	€ 12	€ 14	Bulgaria	€ 10	€ 88	€ 98
Czech Republic	€ 17	€ 26	€ 58	Czech Republic	€ 120	€ 277	€ 397
Cyprus	€ 1	€ 10	€ 6	Cyprus	€ 7	€ 32	€ 39
Denmark	€ 5	€ 19	€ 24	Denmark	€ 35	€ 121	€ 156
Estonia	€ 2	€ 2	€ 4	Estonia	€ 11	€ 16	€ 27
Finland	€ 7	€ 12	€ 18	Finland	€ 42	€ 72	€ 115
France	€ 52	€ 118	€ 170	France	€ 310	€ 692	€ 1,003
Germany	€ 112	€ 200	€ 312	Germany	€ 722	€ 1,200	€ 1,922
Greece	€ 9	€ 40	€ 48	Greece	€ 62	€ 242	€ 304
Hungary	€ 20	€ 11	€ 31	Hungary	€ 140	€ 73	€ 213
Ireland	€ 2	€ 7	€ 9	Ireland	€ 12	€ 46	€ 58
Italy	€ 90	€ 267	€ 357	Italy	€ 550	€ 1,599	€ 2,150
Latvia	€ 5	€ 4	€ 10	Latvia	€ 37	€ 31	€ 68
Lithuania	€ 6	€ 9	€ 15	Lithuania	€ 43	€ 63	€ 105
Luxembourg	€ 0	€ 1	€ 1	Luxembourg	€ 1	€ 4	€ 5
Malta	€ 0	€ 0	€ 0	Malta	€ 0	€ 0	€ 0
Netherlands	€ 10	€ 24	€ 34	Netherlands	€ 63	€ 152	€ 215
Poland	€ 47	€ 102	€ 149	Poland	€ 321	€ 674	€ 995
Portugal	€ 33	€ 30	€ 63	Portugal	€ 220	€ 191	€ 411
Romania	€ 15	€ 32	€ 46	Romania	€ 112	€ 222	€ 334
Slovakia	€ 2	€ 3	€ 5	Slovakia	€ 12	€ 24	€ 36
Slovenia	€ 4	€ 6	€ 10	Slovenia	€ 24	€ 39	€ 64
Spain	€ 65	€ 183	€ 248	Spain	€ 401	€ 1,082	€ 1,483

Low	Female	Male	Total	High	Female	Male	Total
Sweden	€ 7	€ 30	€ 37	Sweden	€ 45	€ 182	€ 227
United Kingdom	€ 63	€ 175	€ 239	United Kingdom	€ 414	€ 1,065	€ 1,479
TOTAL	€ 594	€ 1,368	€ 1,972	**TOTAL**	€ 3,855	€ 8,462	€ 12,317

Table 8.4.7 Health costs – baseline scenario – Industry Group breakdown – Based on a declining discount rate

Low	Female	Male	Total
Maintenance and Repair of Motor Vehicles	€ 552	€ 1,272	€ 1,824
Sales, maintenance and repair of motorcycles and related parts and accessories	€ 40	€ 95	€ 136
TOTAL	€ 592	€ 1,368	€ 1,960
High			
Maintenance and Repair of Motor Vehicles	€ 3,567	€ 7,823	€ 11,389
Sales, maintenance and repair of motorcycles and related parts and accessories	€ 261	€ 585	€ 846
TOTAL	€ 3,828	€ 8,407	€ 12,235

Table 8.4.8 Summary

Costs by Gender (€m)	2010-2019	2020-2029	2030-2039	2040-2049	2050-2059	2060-2069
Female	21 to 146	33 to 224	57 to 386	100 to 655	159 to 1019	224 to 1425
Male	45 to 287	72 to 461	130 to 823	228 to 1427	368 to 2262	526 to 3201
Total	66 to 433	106 to 686	188 to 1209	329 to 2082	529 to 3281	754 to 4626

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