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The Burden of Occupational Cancer In Britain and the Way Forward

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Estimating the Burden of Occupational Cancer in Britain

Aims

- Establish baseline risk
- Identification of major risk factors
  - Carcinogens (42)
  - Cancer sites (23)
  - Industries and occupations (60+)
- Support decisions on priority actions for risk reduction
- Facilitate planning for future needs
- Identify knowledge gaps

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What did we estimate?

- Current Burden of Occupational Cancer:
  - Estimate size of current burden based on past exposures at work
  - Estimation carried out for all substances and circumstances (e.g. work as a painter or welder) in the workplace defined by International Agency for Research on Cancer (IARC) as:
    - » **definite** (group 1) human carcinogen
    - » **probable** (group 2A) human carcinogen

- Prediction of Future Burden of Occupational Cancer
  - Estimate size of future burden based on current and past exposures
  - Demonstrate effect of measures to reduce exposure

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How did we measure burden?

- Measured burden using:
  - » Attributable Fraction: proportion of cases attributable to exposure
  - » Attributable Deaths
  - » Attributable Cancer Registrations (Newly occurring cancers)
- Used data from:
  - Published literature on occupational risks
  - National data sources
    - » Carcinogen exposure database (CAREX)
    - » Labour Force Survey (LFS)
    - » Employment data

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Attributable fraction, deaths and new cancers

Cancer site:	Attributable Fraction(%)			Attributable Deaths (2005)			Attributable Registrations (2004)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Bladder	7.1	1.9	**5.3**	215	30	**245**	496	54	**550**
Breast		4.6	**4.6**		555	**555**		1,969	**1,969**
Larynx	2.9	1.6	**2.6**	17	3	**20**	50	6	**56**
Leukaemia	0.9	0.5	**0.7**	18	5	**23**	30	9	**38**
Lung	21.1	5.3	**14.5**	4,020	725	**4,745**	4,627	815	**5,442**
Mesothelioma	97.0	82.5	**94.9**	1,699	238	**1,937**	1,699	238	**1,937**
Non-Hodgkin's Lymphoma	2.1	1.1	**1.7**	43	14	**57**	102	39	**140**
Non-melanoma Skin Cancer	6.9	1.1	**4.5**	20	2	**23**	2,513	349	**2,862**
Oesophagus	3.3	1.1	**2.5**	156	28	**184**	159	29	**188**
Sinonasal	43.3	19.8	**32.7**	27	10	**38**	95	31	**126**
Soft Tissue Sarcoma	3.4	1.1	**2.4**	11	3	**13**	22	4	**27**
Stomach	3.0	0.3	**1.9**	101	6	**108**	149	9	**157**
Total	8.2	2.3	**5.3**	6,355	1,655	**8,010**	9,988	3,611	**13,598**
Total GB cancers 15+yrs				77,912	72,212	150,124	175,399	168,184	343,583

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Rankings by different burden measures

AFs (%)	Deaths	Registrations	Typical mean YLL (years)
Mesothelioma (95)	Lung (4745)	Lung (5442)	Breast (17.3)
Sinonasal (33)	Mesothelioma (1937)	NMSC (2862)	NHL (16.9)
Lung (14.5)	Breast (555)	Breast (1969)	Sinonasal (16.4)
Bladder (5.3)	Bladder (245)	Mesothelioma (1937)	Mesothelioma (13.9)
Breast (4.6)	Oesophagus (184)	Bladder (550)	Oesophagus (13.7)
NMSC (4.5)	Stomach (108)	Oesophagus (188)	Lung (13.2)
Larynx (2.6)	NHL (57)	Stomach (157)	Stomach (12.3)
Oesophagus (2.5)	Sinonasal (38)	NHL (140)	Bladder (9.6)

AF: attributable fraction; NMSC: non-melanoma skin cancer; NHL: non-Hodgkin lymphoma; YLL: years of life lost

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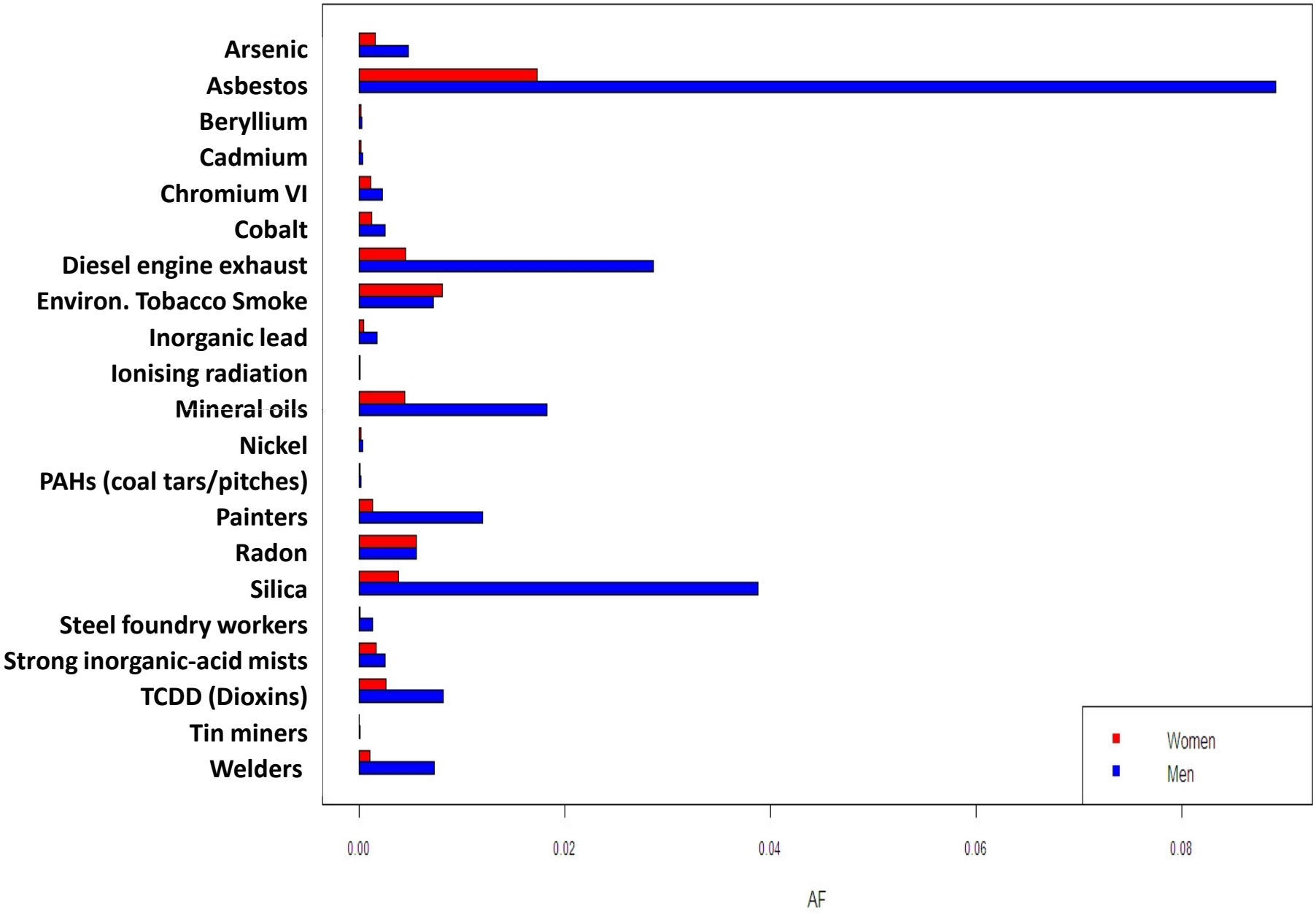
Major occupational carcinogens

Cancer Site	Asbestos	Shift work	Mineral oils	Solar radiation	Silica	Diesel Engine Exhaust	Polycyclic Aromatic Hydrocarcons (Tars)	Painters	Dioxins	Environmental Tobacco Smoke	Radon	Welders	All
Bladder			296			106		71					550
Breast		1,957											1,969
Larynx	8												56
Leukaemia													38
Lung	2,223		470		907	695		282	215	284	209	175	5,442
Mesothelioma	1,937												1,937
Non-Hodgkins Lymphoma									74				140
Non-Melanoma Skin Cancer			902	1,541			475						2,862
Oesophagus													188
Sinonasal			55										126
Soft Tissue Sarcoma									27				27
Stomach	47							83					157
Total Registrations	**4,216**	**1,957**	**1,722**	**1,541**	**907**	**801**	**475**	**437**	**316**	**284**	**209**	**175**	**13,598**

Lung cancer by carcinogen/occupation



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Major industry sectors

Industry Sector	Asbestos	Shift work	Mineral oils	Solar radiation	Silica	DEE	PAHs (Tars)	Painters	Dioxins	ETS	All
Total Agriculture and Farming				**135**					**55**		**263**
Iron/steel industries			0	0		0	4		75		135
Manufacture industrial chemicals	64				1	1			11		121
Metal workers			1,252								1,252
Mining	197			31	29	43					302
Non-ferrous metal industries				9	4	2			50		159
Total Manufacturing	**535**		**1,722**	**163**	**200**	**80**	**4**	**102**	**254**		**3,944**
Total Construction	**2,773**			**841**	**707**	**290**	**471**	**334**		**36**	**5439**
Land transport	133			6		350				3	505
Personal/household services	361		7	14		29				22	804
Public admin./defence				240						20	273
Total Service Industry	**573**	**1,957**	**7**	**402**		**431**			**7**	**248**	**4,177**
Total Registrations	**4,216**	**1,957**	**1,722**	**1,541**	**907**	**801**	**475**	**437**	**316**	**284**	**13,598**

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Construction Industry

	AF%	Deaths	Registrations
Construction	2.30	3457	4668
Painters and decorators (construction)	0.17	254	334
Roofers, road surfacers, Roadmen, Paviors (Construction)	0.00	4	471
Total Construction	**2.46**	**3694**	**5439**

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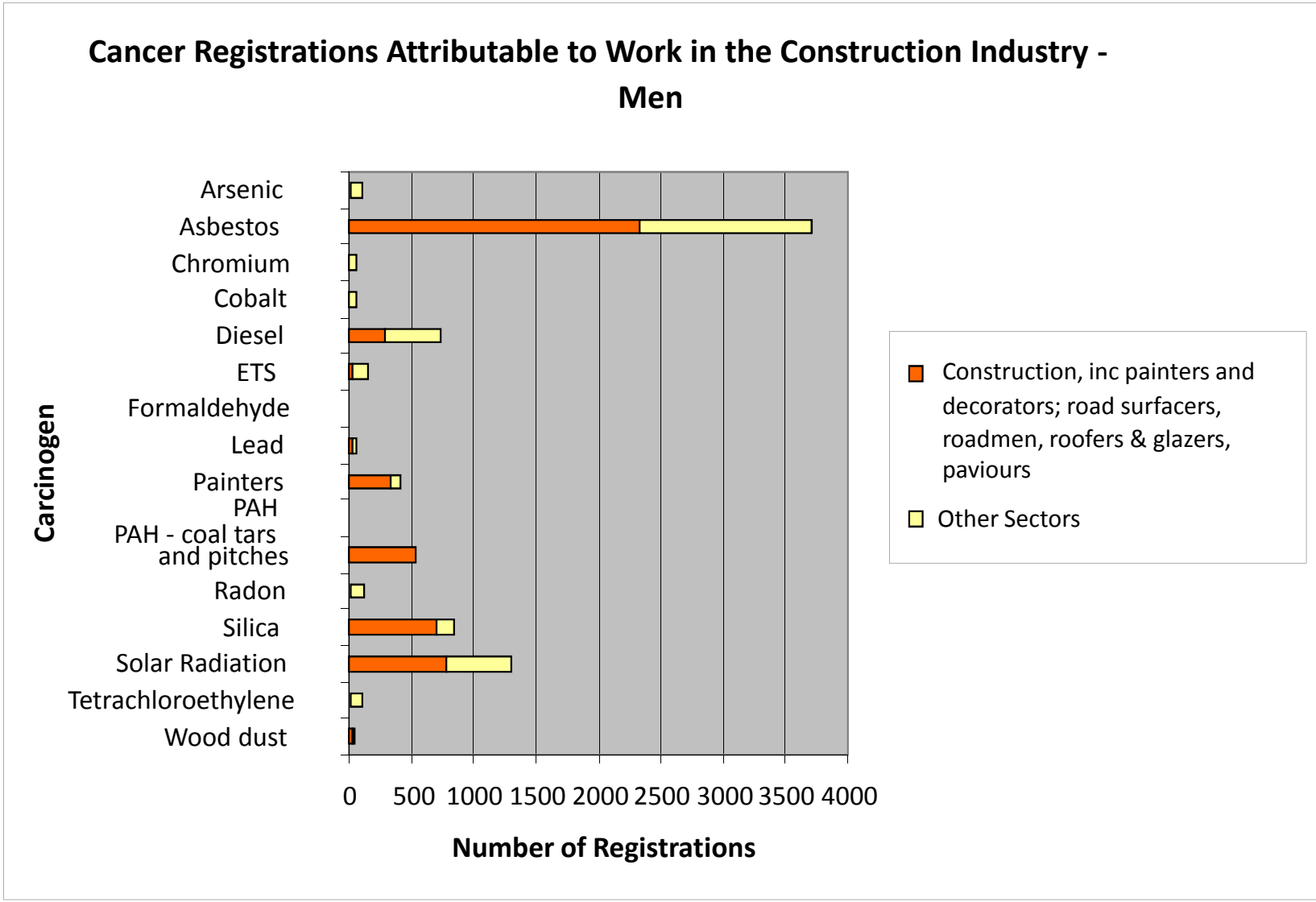
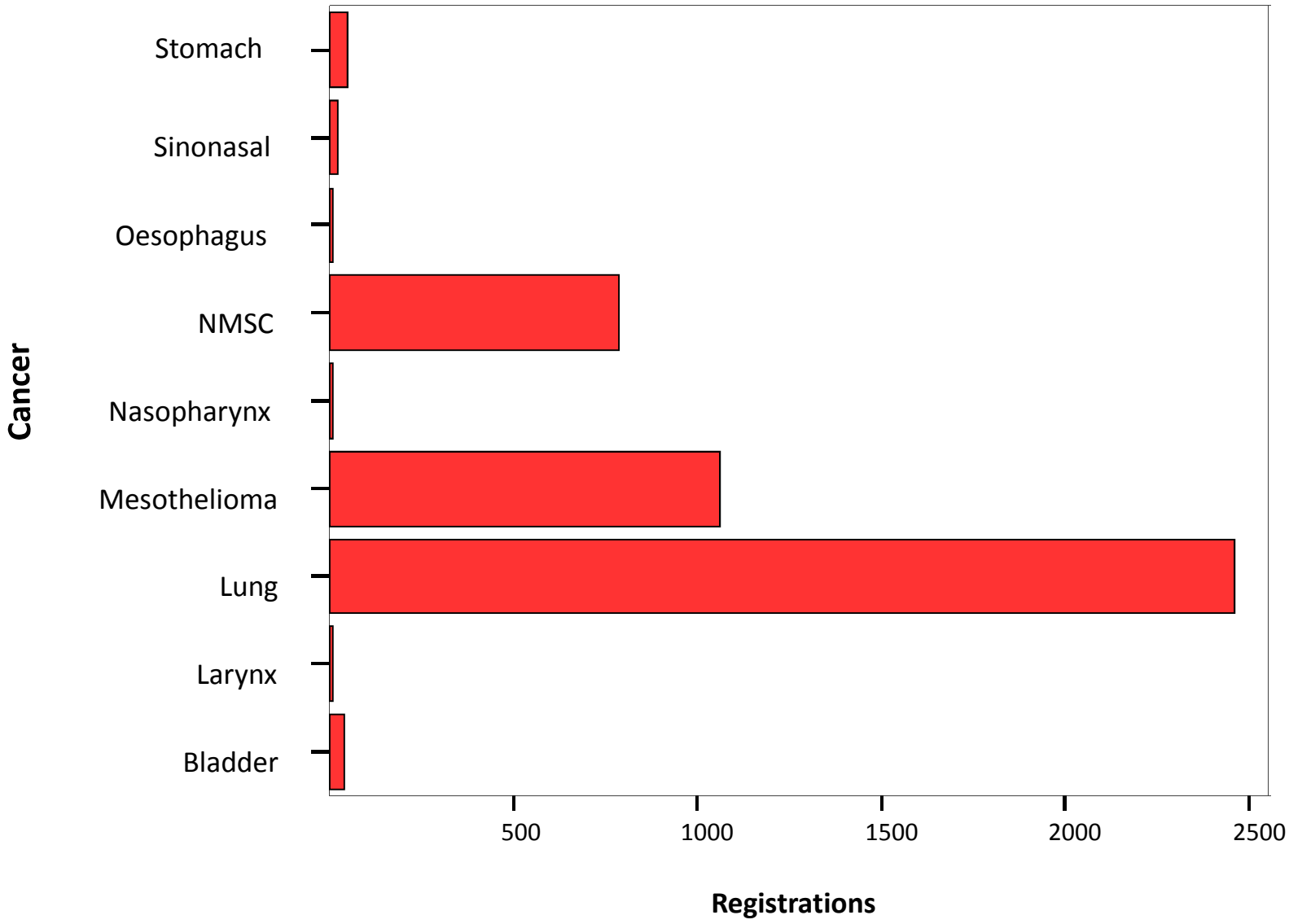
Numbers exposed

- Large numbers exposed over the risk exposure period (10-50 years before cancer diagnosis)
- Examples:
  - Diesel Engine Exhaust 484,000
  - Environmental tobacco smoke 124,000
  - Painters & decorators in construction 922,000
  - Radon 98,000
  - Silica 2,040,000
  - Solar radiation 1,575,000
  - Wood dust 1,034,000


Cancer Registrations Attributable to Work in the Construction Industry - Men
Carcinogen
Arsenic
Asbestos
Chromium
Cobalt
Diesel
ETS
Formaldehyde
Lead
Painters
PAH
PAH - coal tars and pitches
Radon
Silica
Solar Radiation
Tetrachloroethylene
Wood dust
0
500
1000
1500
2000
2500
3000
3500
4000
Number of Registrations
Construction, inc painters and decorators; road surfacers, roadmen, roofers & glazers, paviours
Other Sectors

Attributable Registrations by Cancer Site for Work in the Construction Industry: Men



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Predicting Future Burden

- Changing balance between past and future exposure as we predict forward in time

Baseline scenario – no intervention, continuing pattern of past exposure

Interventions - can test, for example:

- Introduction exposure standards or reduction current limits
- Improved compliance to an existing exposure standard
- Different timings of introduction (2010, 2020 etc)
- Compliance levels e.g. according to workplace size (self-employed, 1-49, 50-249, 250+ employees)

Compare predicted numbers from baseline 'no change' with interventions

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Illustration of policy options: silica and lung cancer

Silica: current limit 0.1 mg/m^3, 33% compliance

794 newly occurring lung cancers in 2010

No action, annual numbers remains the same

- Reduce exposure limit in all workplaces to:
  - ➢0.05 mg/m^3 in 2010
  - ➢0.025 mg/m^3 in 2010
- Improve compliance from 33% to 90% in all workplaces
- Successively enforce a new limit, 0.05 mg/m^3, and improve compliance in workplaces of different sizes

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Predicted lung cancers in 2060 from silica exposure

Test scenarios	Forecast cancers	Avoided cancers
Base-line: Limit 0.1mg/m^3, compliance 33%	794	
Reduce exposure limit		
Exposure limit 0.05mg/m^3, compliance 33%	592	202
Exposure limit 0.025mg/m^3, compliance 33%	409	385
Reduce exposure limit AND improve compliance to 90%		
Exposure limit 0.1mg/m^3, compliance 90%	102	693
Exposure limit 0.05mg/m^3, compliance 90%	49	745
Exposure limit 0.025mg/m^3, compliance 90%	21	773
Reduce limit to 0.05%, improve compliance by workplace size		
90% 250+, 33% <250, self employed	499	295
90% 50+; 33% <50, self employed	451	344
90% all sizes employed; 33% self employed	261	533
90% all workplaces	49	755

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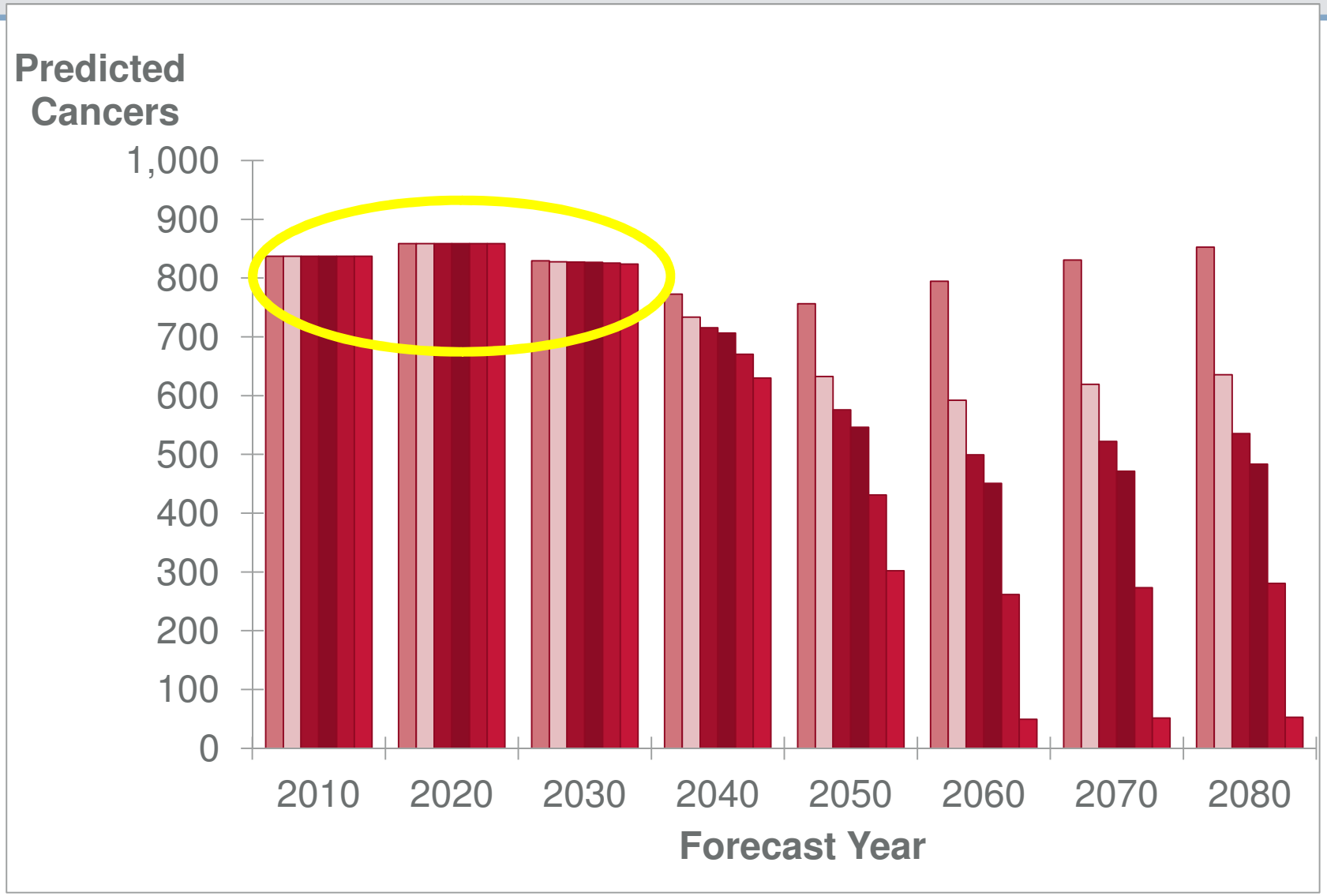
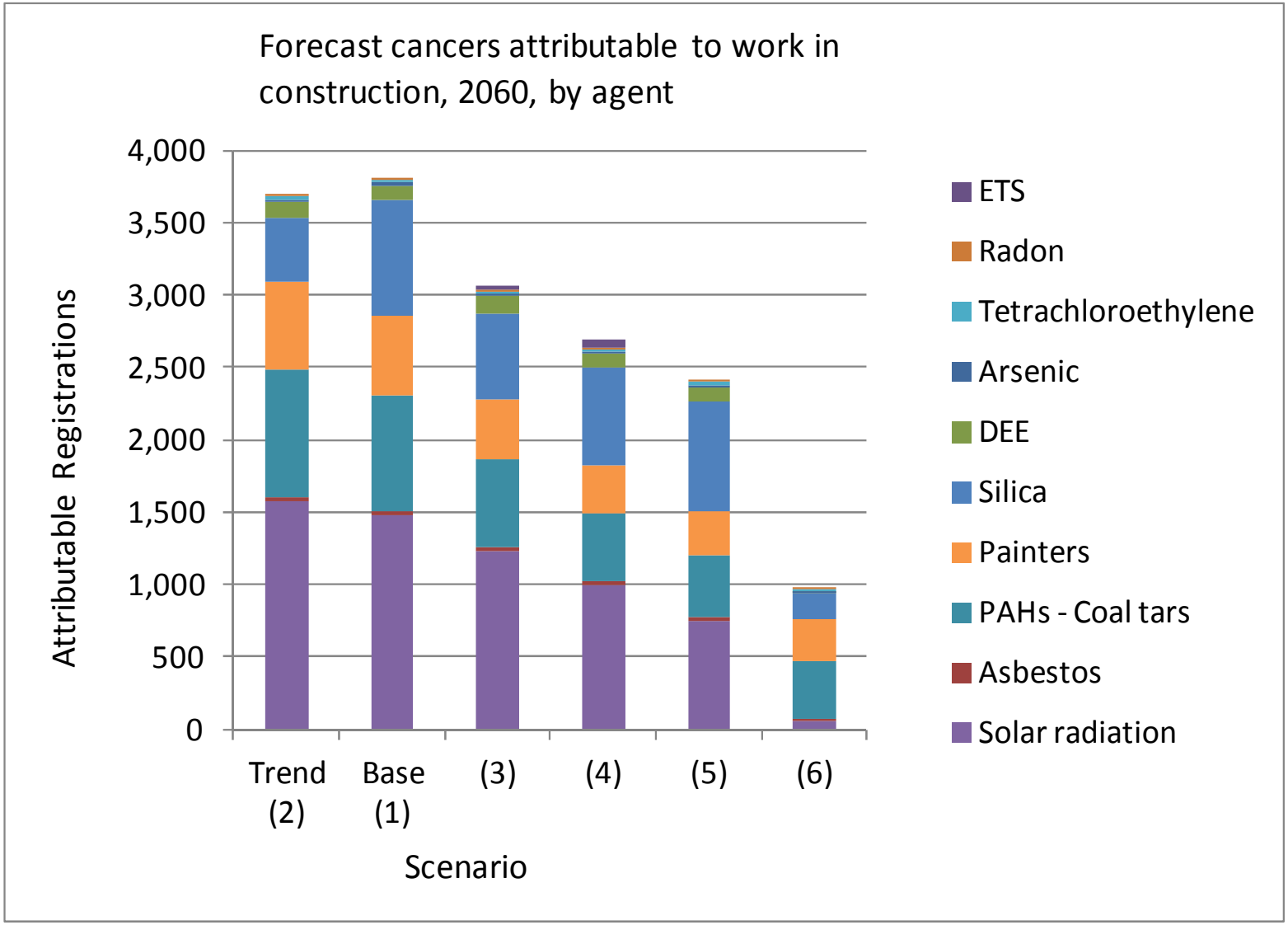
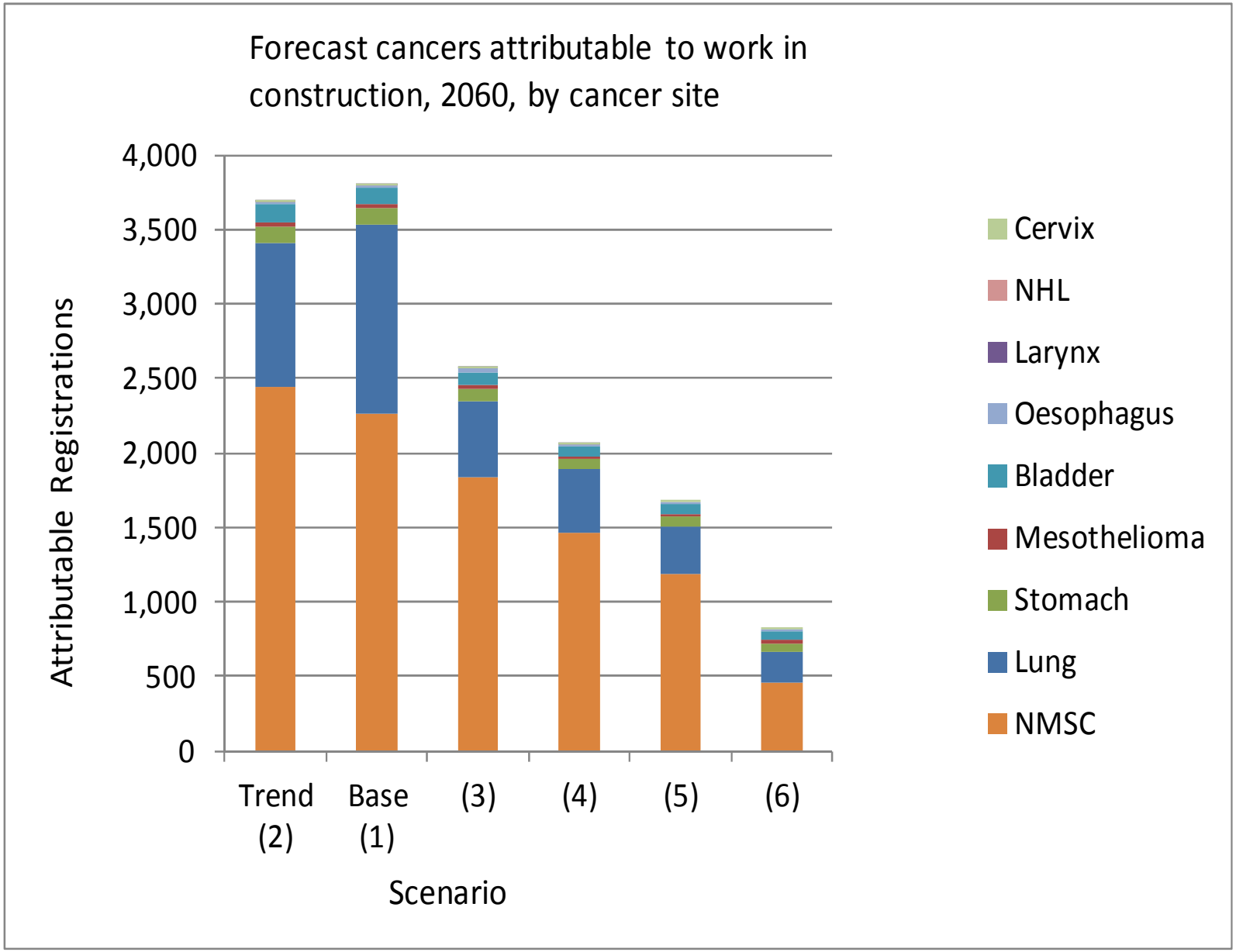
Predicted lung cancers from silica exposure:
Effect of improved compliance by workplace size



Predicting future cancers for the construction industry

Carcinogen	Interventions tested
Arsenic	Introduce exposure standard (0.008 mg/m^3) in 2010, 90% compliance; 0.004mg/m^3, 0.002mg/m^3, 99% compliance
Asbestos	Maintain exposure standard = 0.1 f/ml in 2010, 90% compliance, then 0.05f/ml, 0.01f/ml, 0.001f/ml, 99% compliance
DEE	Introduce exposure standard (0.1 mg/m^3) in 2010, 90% compliance; 0.05mg/m^3, 0.01mg/m^3, 99% compliance
ETS	Effects of office smoking restrictions and then indoor bans
PAHs (coal tar & pitches)	Different reductions in excess risk in different years e.g. 75% of current in 2010, 50% in 2020, 25% in 2030 etc
Radon	Different reductions in exposed numbers e.g. 10% in 2010, further 10% in 2020 and 2030 etc
Silica	Introduce exposure standard (0.1 mg/m^3) in 2010, 90% compliance; 0.05mg/m^3, 0.025mg/m^3, 99% compliance
Solar radiation	Reduce time spent outdoors
Tetrachloroethylene	Introduce exposure standard (4.2 mg/m^3) in 2010, 90% compliance; 2.1mg/m^3, 1.5mg/m^3, 99% compliance
Work as a painter	Different reductions in excess risk in different years e.g. 75% of current in 2010, 50% in 2020, 25% in 2030 etc


Forecast cancers attributable to work in construction, 2060, by agent
Attributable Registrations
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Trend (2)
Base (1)
(3)
(4)
(5)
(6)
Scenario
ETS
Radon
Tetrachloroethylene
Arsenic
DEE
Silica
Painters
PAHs - Coal tars
Asbestos
Solar radiation


Forecast cancers attributable to work in construction, 2060, by cancer site
Attributable Registrations
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Trend (2)
Base (1)
(3)
(4)
(5)
(6)
Scenario
Cervix
NHL
Larynx
Oesophagus
Bladder
Mesothelioma
Stomach
Lung
NMSC

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Summary of Future Burden Results

- 14 agents account for 85.7% current occupation attributable cancer giving 12,000 cancers in 2010
- Will rise to nearly 13,000 by 2060 given current trends in employment and exposure levels.
- No impact seen until 2030 because of general increase in cancers due to aging population
- With modest intervention over 2,000 cancers can be avoided by 2060 (including 376 lung, 928 breast cancers, 432 NMSC)
- With stronger interventions nearly 8,500 can be avoided by 2060 (including 1,732 lung, 3,062 breast and 3,287 NMSC)
- Methods enables effective interventions to be identified
- Need to monitor exposure levels in future to assess whether interventions have been successful

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Prevention

- Our study has showed that workplace cancers are a concern
- The current occupational cancer burden is mostly caused by a small number of agents
- Without any additional actions burden in the future will stay approximately the same
- Exposures have been decreasing steadily over time
- Focused effort could ensure the occupational cancer burden becomes much less:
  - Small and medium sized companies, self employed workers
  - Dusts, fibres, fumes, gases through inhalation e.g. asbestos, silica, wood dust, diesel exhaust, welding fumes
  - Solar radiation – encourage use of sunscreens and appropriate clothing
  - Shift (night) work

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Thank you