SKIN CANCER

ESTIMATES GLOBAL CARBON IMPACT

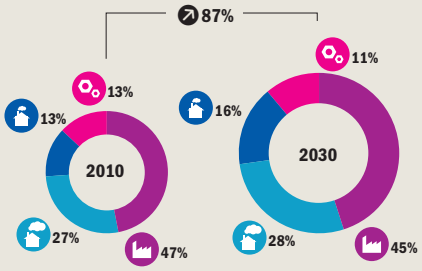
2010 EFFECT TODAY

DEATHS PER YEAR **20,000**

2030 EFFECT TOMORROW

DEATHS PER YEAR **45,000**

MORTALITY IMPACT



CONFIDENCE **ROBUST**

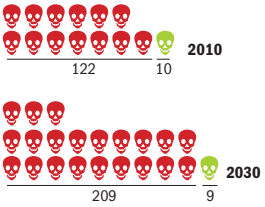
SEVERITY

AFFECTED

MDG EFFECT

- Exposure to UV rays from the sun is the principal cause of skin cancers such as melanoma
- Greenhouse gases that warm the planet are also largely responsible for depleting the Earth's upper atmosphere, allowing more UV radiation to reach ground levels
- The highly successful Montreal Protocol has phased out most ozone-depleting substances, however, so the root cause of the problem is already being addressed, with ozone depletion now set to recover
- Skin cancer rates have and will continue to increase, though, because of the lapse of time between accumulated UV exposure and the development of skin cancer

RELATIVE IMPACT



HOTSPOTS

2010 2030

3,500 **USA** 8,000

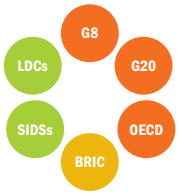
2,000 **CHINA** 4,250

850 **GERMANY** 1,750

800 **UNITED KINGDOM** 1,750

850 **RUSSIA** 1,500

GEOPOLITICAL VULNERABILITY



Deaths

Developing Country Low Emitters

Developing Country High Emitters

Developed

Other Industrialized

= Deaths per 10 million

Change in relation to overall global population and/or GDP

Tackling the hole in the ozone layer has been one of the most successful examples of international cooperation and environmental protection to date. The Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer has been effectively phasing out highly potent GHGs and ozone-depleting substances like chlorofluorocarbons (CFCs) and halocarbons (HCFCs). As a result, experts have suggested amending the Protocol, first signed in 1987, to tackle additional GHGs in order to support other global efforts on climate change (Molina et al., 2009).

The ozone layer was at its maximum level of depletion during the late 1990s and through the last decade but is expected to recover rapidly in the years ahead (Dameris, 2010). Much of the damage to human health, however, has already been done. The slow recognition of the risks involved and delayed action will ultimately result in hundreds of thousands of deaths due to skin cancer, mainly in developed countries, that would not have occurred had the ozone layer remained stable (Martens, 1998; UNEP, 2002b).

HAZARD MECHANISM

Excessive ultraviolet (UV) radiation from accumulated sun exposure is now well recognized as the main cause of skin cancer (Armstrong and Kricker, 2001; Saraiya et al., 2004; Ramos et al., 2004). Depletion of the ozone layer exposes populations to more UV radiation, increasing skin cancer rates (UNEP, 2002b; Lucas et al., 2006). Aside from the ozone layer itself, radiation levels vary due to a number of other factors, including: 1) sun elevation – when the sun is higher in the sky, more UV radiation reaches ground level, 2) latitude – radiation being higher closer to the equator, 3) altitude – with every 1,000 metres gained in altitude, UV radiation increases 10% and 4) ground reflection, in that snow will reflect up to 80% of all UV rays and sand only 15% (WHO, 2002a). People's behavioural patterns, such as an increasing trend in "sun-worshipping" or carelessness about sunscreen and other protection measures, also play an important role in incidence of skin cancer at the population level (Martens, 1998; Coups et al., 2008). Skin cancer is also a major occupational hazard for outdoor workers (Vecchia et al. (eds.), 2007). Fair-skinned people are more susceptible to cancer, and childhood exposure to UV increases risks, although the onset of melanoma and other skin cancers generally occurs later in life (Armstrong and Kricker, 2001).

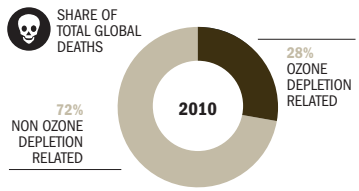
IMPACTS

The annual global impact of the carbon economy on skin cancer is estimated to have been 20,000 deaths for the year 2010, with that figure rising to 45,000 deaths per year in 2030 in a doubling of impact as a share of global population. It is estimated that 65,000 people were affected by skin cancer in 2010 as aggravated by the carbon economy, a figure that is expected to increase to almost 150,000 people by 2030. Developed and industrialized or transition economies in Australasia, Europe and North America are most severely affected due to significant proportions of populations with high-risk skin types in these countries. Australia and New Zealand have the highest rates of carbon-economy-aggravated skin cancer mortality as a share of population. The largest total impacts are felt in the US, China, Germany, Russia, the UK, France and Italy. Estimated annual mortality for the US and China is at 3,500 and 2,000 respectively, rising to 8,000 and 4,500 by 2030.

THE INDICATOR

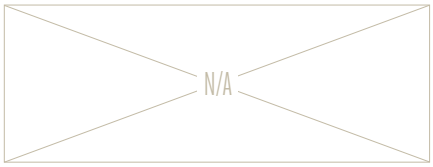
The indicator measures the impact on skin cancer rates due to UV radiation amplified by ozone depletion in the upper atmosphere (Martens, 1998). It relies on World Health Organization (WHO) data for skin cancer incidence (WHO BDD, 2012). The indicator is also adjusted to account for a number of closely related but independent factors, including the role of climate change in slowing or speeding the recovery of ozone in the upper atmosphere for different regions, the aging population, and the aggravating effect of increased artificial UV exposure (Bharath and Turner, 2009; Waugh et al., 2009). A key limitation is that the UV radiation impact was only available for Australia, which has had to serve as a global proxy, although the WHO base data already controls for prevalence of the disease internationally.

BIGGER PICTURE

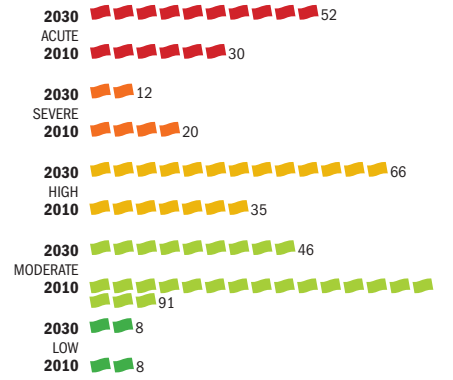


SURGE

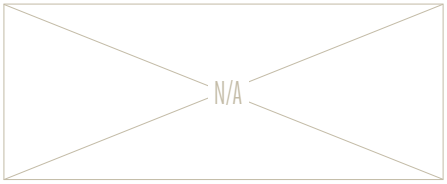
OCCURRENCE



VULNERABILITY SHIFT



PEAK IMPACT



GENDER BIAS

INDICATOR INFORMATION

MODEL: Martens, 1998; WHO IARC, 2005

BASE DATA: WHO, 2009

= 5 countries (rounded)

THE INDICATOR

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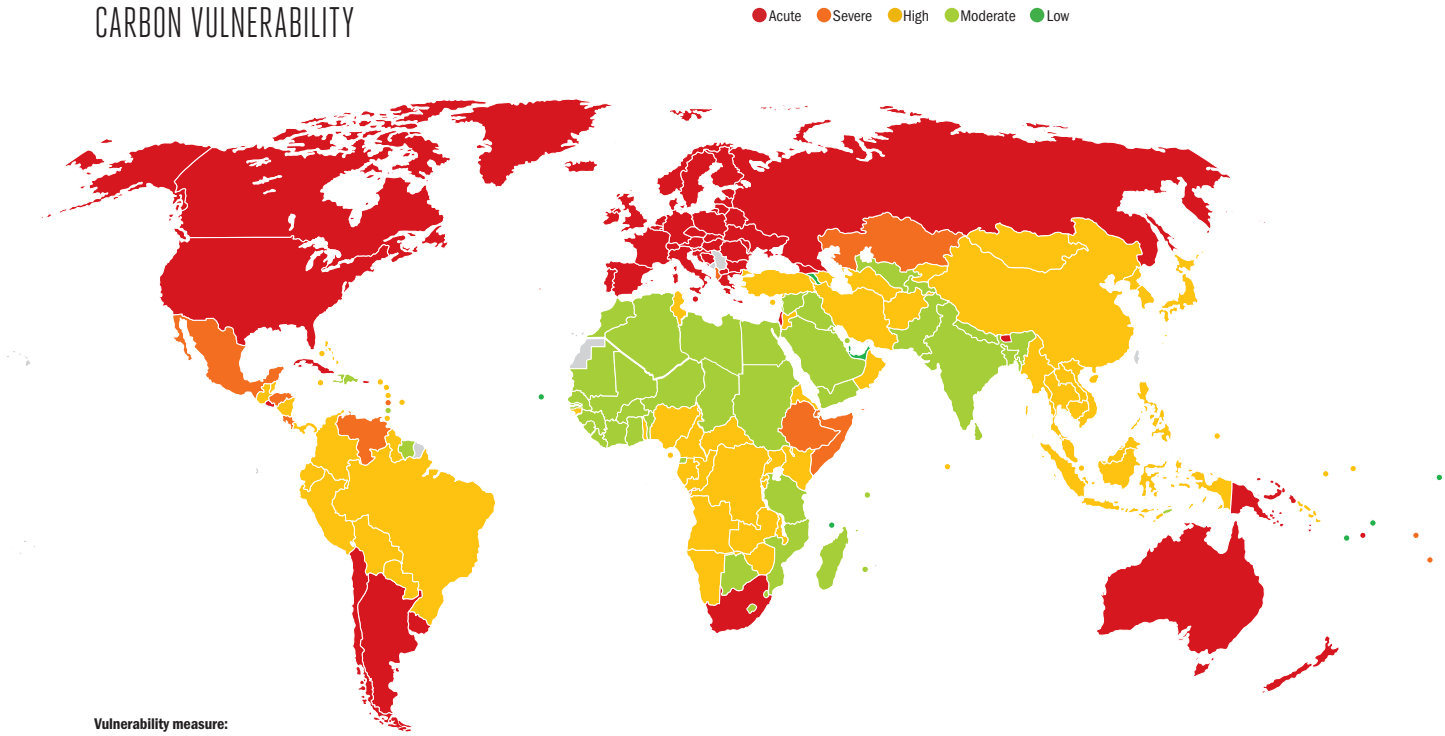
ESTIMATES COUNTRY-LEVEL IMPACT

COUNTRY	2010	2030	2010	2030
ACUTE				
Argentina	250	600	450	1,000
Australia	500	1,250	2,500	6,000
Austria	100	250	550	1,000
Belarus	70	150	100	250
Belgium	100	200	500	1,000
Bhutan	5	20	10	30
Bosnia and Herzegovina	30	60	50	100
Bulgaria	95	150	150	300
Canada	300	700	1,500	3,500
Chile	95	200	150	400
Croatia	70	150	150	250
Cuba	100	200	200	350
Czech Republic	150	250	250	500
Denmark	80	150	400	800
El Salvador	40	100	70	200
Estonia	20	35	35	60
Fiji	5	15	10	25
Finland	60	150	300	600
France	750	1,500	3,500	7,500
Georgia	30	50	50	90
Germany	850	1,750	4,250	8,250
Greece	100	200	500	1,000
Hungary	150	250	250	500
Iceland	5	10	15	40
Ireland	55	150	250	650
Israel	85	200	400	1,000
Italy	650	1,250	3,000	5,750
Latvia	35	65	60	100
Lebanon	50	100	90	200
Lithuania	30	65	60	100
Luxembourg	5	10	20	50
Macedonia	35	70	60	100
Malta	1	5	15	25
Moldova	35	70	55	100
Netherlands	250	500	1,000	2,250
New Zealand	100	250	550	1,250
Norway	100	200	450	1,000
Papua New Guinea	75	200	100	350
Poland	500	1,000	900	1,750
Portugal	100	250	550	1,000
Romania	200	400	350	700
Russia	850	1,500	1,500	3,000
Slovakia	55	100	100	200
Slovenia	35	70	150	350
South Africa	350	650	650	1,250
Spain	400	750	2,000	3,750
Sweden	150	350	800	1,500
Switzerland	100	200	550	1,000
Ukraine	300	600	550	1,000
United Kingdom	800	1,750	3,750	8,000
United States	3,500	8,000	15,000	40,000
Uruguay	25	60	50	100
SEVERE				
Albania	10	25	20	40
Costa Rica	20	50	35	95
Djibouti	5	10	5	15
Ethiopia	300	850	450	1,250
Honduras	25	70	45	100
Kazakhstan	50	100	85	200
Mexico	400	950	750	1,750
Saint Vincent	1	1		1
Somalia	40	150	65	200
Tonga		1		1
Tuvalu				
Venezuela	100	250	200	500
HIGH				
Afghanistan	50	150	80	250
Angola	30	95	50	150
Antigua and Barbuda				1
Azerbaijan	10	30	20	50
Bahamas	1	1	5	10
Barbados	1	1		1
Belize	1	1	1	5
Bolivia	25	70	50	150
Brazil	600	1,500	1,000	2,500
Burundi	10	25	15	40
Cambodia	30	80	50	150
Cameroon	30	75	45	100
Central African Republic	5	15	10	25
China	2,000	4,250	3,750	7,750
Colombia	100	250	200	450
Congo	5	15	10	25
Cyprus	5	5	15	35
Dominica				
DR Congo	100	350	150	550
Ecuador	40	100	75	200
Eritrea	10	30	15	45
Gabon	1	5	5	15
Guatemala	40	100	70	200
Guinea-Bissau	1	5	1	5
Guyana	1	1	1	5
Indonesia	400	900	700	1,500
Iran	150	350	250	650
Jamaica	5	10	5	15
Japan	400	750	1,750	3,500

Additional mortality - yearly average

CARBON VULNERABILITY



Vulnerability measure:
comparative mortality as a share of population (national)

COUNTRY	2010	2030	2010	2030
Jordan	10	30	15	50
Kenya	50	150	85	200
Kyrgyzstan	5	15	10	25
Laos	15	35	20	60
Malawi	20	55	30	90
Malaysia	40	95	70	150
Maldives	1	1	1	5
Marshall Islands		1		
Micronesia		1		1
Mongolia	5	10	5	20
Myanmar	75	150	100	250
Namibia	5	10	5	20
Nicaragua	10	20	10	35
Nigeria	200	550	300	900
North Korea	45	90	70	150
Oman	5	15	5	25
Palau				
Panama	5	10	10	20
Paraguay	15	45	30	85
Peru	75	200	150	350
Philippines	200	450	350	800
Rwanda	15	45	25	70
Saint Lucia		1		
Sao Tome and Principe	1	1		1
Singapore	10	25	55	100
Solomon Islands	1	5	1	5
South Korea	100	250	550	1,250
Thailand	150	350	250	600
Togo	10	25	15	40
Trinidad and Tobago	1	5	1	5
Tunisia	15	35	25	65
Turkey	100	250	200	450
Turkmenistan	5	15	10	30
Uganda	45	150	70	250
Vietnam	250	600	400	950
Zambia	20	55	30	85
Zimbabwe	20	55	35	90
MODERATE				
Algeria	20	50	35	85
Bahrain		1	1	1
Bangladesh	85	200	150	350
Benin	10	25	15	40
Botswana	1	5	5	10
Brunei		1		1
Burkina Faso	10	35	15	55
Chad	10	35	15	55
Cote d,Ivoire	20	45	30	75
Dominican Republic	5	15	10	25
Egypt	45	100	80	200
Equatorial Guinea	1	1	1	5
Gambia	1	1	1	1
Ghana	25	60	40	100
Grenada				
Guinea	5	20	10	30
Haiti	1	1		1
India	400	900	600	1,500
Iraq	20	60	35	100
Kuwait	1	1	1	5
Lesotho	1	1	1	5
Liberia	1	10	5	15
Libya	1	10	5	15
Madagascar	10	35	20	60
Mali	5	20	10	35
Mauritania	5	10	5	15
Mauritius	1	1	1	5
Morocco	15	40	30	70
Mozambique	25	60	35	95
Nepal	15	35	20	55
Niger	10	40	15	60
Pakistan	90	250	150	400
Saudi Arabia	15	45	60	200
Senegal	5	20	10	30
Seychelles				
Sierra Leone	5	10	5	15
Sri Lanka	20	45	35	80
Sudan/South Sudan	45	100	70	200
Suriname		1		1
Swaziland	1	1	1	5
Syria	15	40	25	75
Tajikistan	5	10	5	20
Tanzania	15	40	25	65
Timor-Leste	1	1	1	5
Uzbekistan	25	65	40	100
Yemen	15	55	20	90
LOW				
Armenia				
Cape Verde				
Comoros				
Kiribati				
Qatar				
Samoa				
United Arab Emirates				
Vanuatu				

Additional persons affected - yearly average