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.
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.
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### Table: Additional mortality - yearly average

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

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### Additional persons affected - yearly average