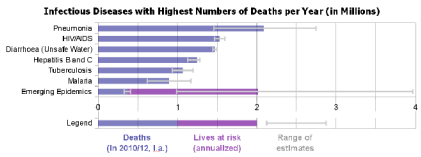
Data-based Recommendations on Targets Proposed by the UN OWG

Proposal to the UN Open Working Group on Sustainable Development Goals with Regard to their Zero Draft, Revision 1, as well as to the Global Burden of Disease Study and the WHO Global Health Estimates

Table of Contents



1 Introduction

This proposal provides data and specific suggestions on several global targets, which have been proposed by the United Nations' Open Working Group on Sustainable Development Goals (OWG).[1] These targets were developed in order to generate successors to the Millennium Development Goals.

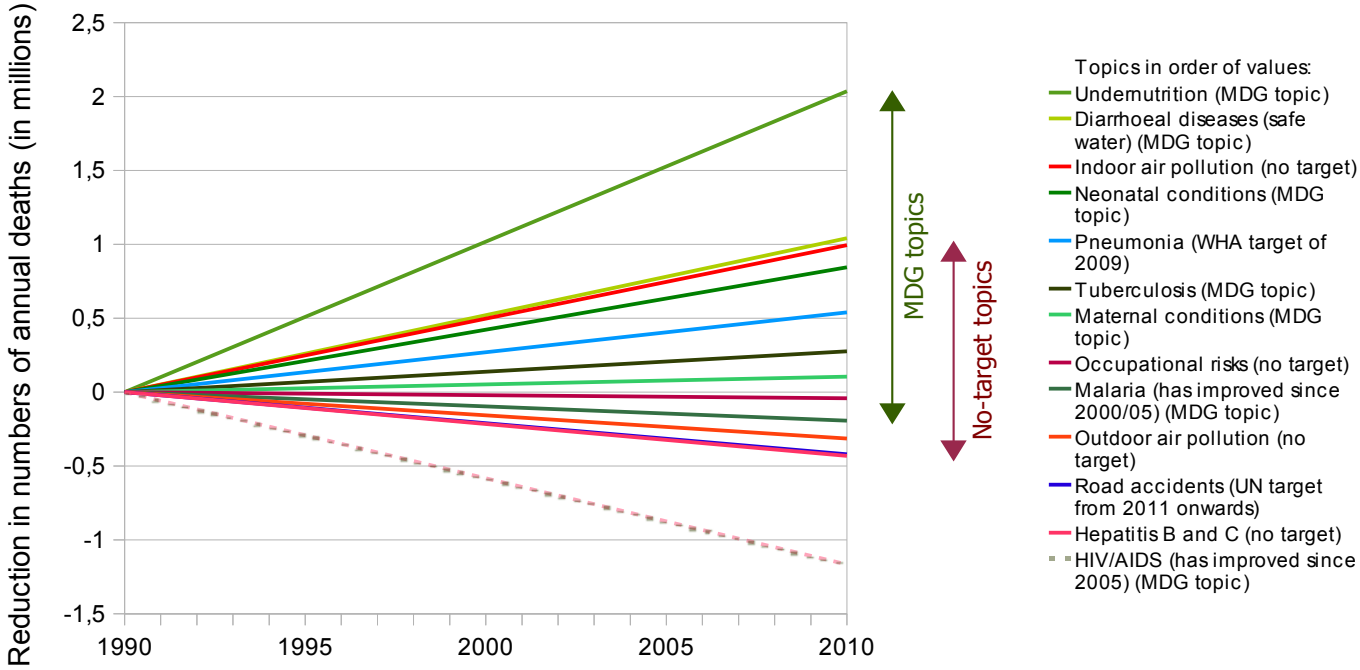
Global2015 conducts research and produces wide-reaching reports related to topics of significant global importance and which have the potential to be improved. In the following we have produced a pre-release excerpt of an upcoming full review related to the setting of targets for the post-2015 development agenda, drawing from statistical data and trend analyses. Providing decision-makers with unbiased information on the most important global challenges is a key aim of Global2015.

Available statistical data shows the *topic-related relevance and feasibility* of targets proposed for major global challenges such as poverty, food insecurity, air pollution, climate change and epidemics

(for details, see section 3). Nevertheless, some targets could reflect current trends or the scale of impacts to humans in a more appropriate manner (see section 2). This ties into the work of our upcoming review, which indicates that topics supplied with a target show more improvement than those without a target.

The proposal utilizes data from the latest version of the *Global Burden of Disease study (GBD)*, which covers 291 diseases and injuries as well as 67 risk factors to human health, in collaboration with scientific institutes and the WHO (GBD).[2] The latest data available from UN organizations and scientific publications has also been considered. This includes the *WHO Global Health Estimates* of June 2014, covering 163 diseases and injuries (WHO).[3]

Progress Diagram: Reduction in Numbers of Annual Deaths 1990–2010



Data source: GBD 2012, pp. 2105–2109, 2238–2240. Diagram: © Global2015.

The progress diagram above indicates best improvements on undernutrition – with a decrease by more than 2 million annual deaths since 1990[4] – and diarrhoeal diseases (which are related to unsafe water). On the other hand, mortality has worsened the most in relation to road accidents and hepatitis B and C (except for HIV/AIDS, for which deaths have increased in comparison to 1990, but decreased by 0.7 million since 2005 [UNAIDS][5]).

All topics with a time-bound and quantifiable MDG target demonstrated a reduction in numbers of deaths between 1990 and 2010, except for HIV/AIDS and malaria if compared to 1990 (since 2000, malaria deaths also decreased, by 0.25 million [WHO]).[6] The covered MDG topics are presented in the diagram in different shades of green. Topics which have no target (or only a recently set target which would not have affected 2010 data) show a smaller reduction in numbers of deaths or even an increase in mortality. These topics are displayed in different shades of red or blue, respectively. The *relationship between target setting and progress* can also be seen when further topics are included or other data

sources are used. Several topics have more data points in a series which indicate that progress accelerated after the time-bound MDG targets were set (Wang et al.; Kassebaum et al.; i.a.).[7] The relation is not necessarily one of causation, instead there is probably an interaction of multiple causes, but target-setting appears to have an influence on the outcomes. Targets matter.

2 Data and Recommendations on Several Targets Proposed in the Zero Draft

The UN Open Working Group proposed a number of global targets for the post-2015 development agenda (OWG).[8] In the following, we consider several proposed targets which have a target year and can be quantified (e.g. a reduction by say 50% or a stabilization), or the provision of such. We selected seven targets according to data on their severity as well as options to improve them.

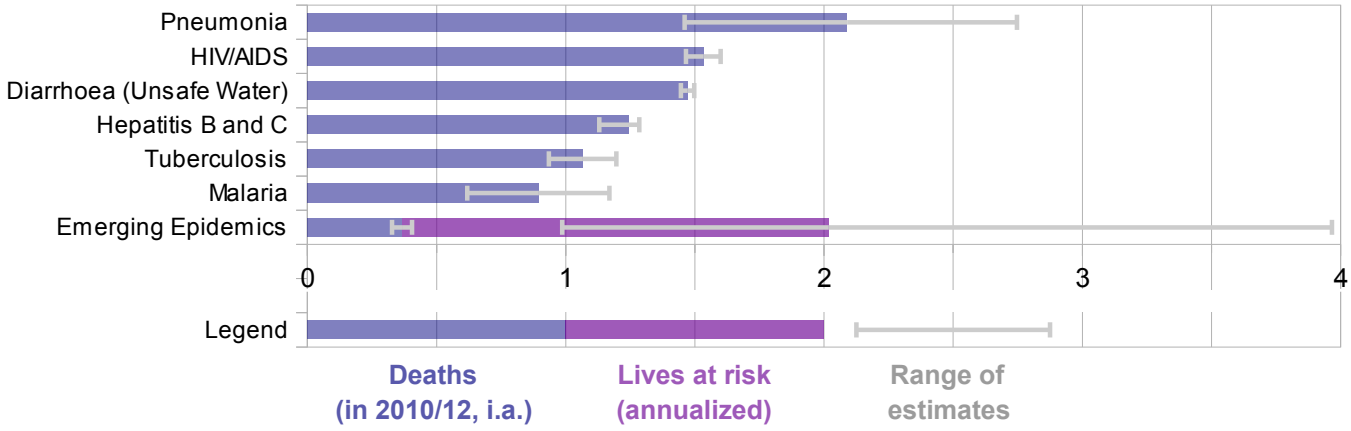
Applicable to all targets having a target year, a *general base year* of the SDG targets should be defined in the final outcome document (e.g. 2015, in order to directly continue from the MDG targets).

Proposed Target 3.3

"by 2030 end the epidemics of HIV/AIDS, tuberculosis, malaria, and neglected tropical diseases"

Available data affirms the importance of ending the above mentioned epidemics, but also indicates *issues of similar severity* that need to be addressed, namely pneumonia, hepatitis B and C as well as emerging epidemics. The target is right to again include a compelling reference to single diseases, which have been very useful for the MDGs as a whole. Among the MDGs, the health topics are among the most successful in terms of mobilization and target achievement. However, the MDGs do not consider all of the most severe epidemics, those of which deserve more attention in the new set of goals and targets. They are not fresh topics, but we are still far from closing the book on them. On a further note, ending HIV/AIDS may not make it superfluous to refer to *universal access to treatment*.

Infectious Diseases with Highest Numbers of Deaths per Year (in Millions)



Data sources: GBD 2012, pp. 2105–2107; WHO 2014; UNAIDS 2013; i.a.[9] Diagram: © Global2015.

Pneumonia kills between 585 000 and 1.3 million children under the age of five per year, and 1.46–2.7 million people in total (GBD; Fischer Walker et al.; derived from WHO).[10] Pneumonia most likely claims the highest death toll of all infectious diseases. Among the fatalities, children under five make up 40.7% (GBD).[11] Total deaths from the three most common types of pneumonia decreased by approximately 27.0% between 1990 and 2010 (GBD).[12] The World Health Assembly (WHA) agreed upon targets, which are limited to children under the age of five: to reduce mortality from pneumonia by 65% and to reduce the incidence of severe pneumonia by 25% by 2015, using 2000 as a baseline.[13] Correspondingly, under-5 deaths from lower respiratory infections, mainly pneumonia,[14] decreased by 40.2% between 2000 and 2012 (WHO).[15] This progress is not on track to meet the WHA target. UNICEF and WHO called pneumonia "the forgotten killer of children" (UNICEF et al.).[16] For these reasons, pneumonia should be considered in the set of post-2015 targets.

- The inclusion of a *percentage reduction* could use a figure considerably larger than 20% over the 15 year time frame from 2015 to 2030 in order to encourage improvement upon the current trend of a 27% reduction in total deaths seen over the 20 year period from 1990 to 2010 (GBD).[17]
- If limited to under-5 deaths, the percentage should be significantly larger than 50% over the 15 year time frame by 2030 if the current trend seen over the 12 year period from 2000 to 2012 is to be surpassed.
- Alternatively, the target could refer to *improving by a given percentage upon the current trend* (without taking into account figures on current trends directly).

Hepatitis B and C result in 1.03–1.29 million deaths per year (WHO; GBD),[18] a higher number of deaths than the figures for malaria or tuberculosis (GBD; WHO).[19] Annual deaths from hepatitis B and C escalated by approximately 432 000 or 50.6% between 1990 and 2010 (GBD)[20], and the number of people carrying a hepatitis C infection increased by about 51.6% from 1990 to 2005 (Mohd Hanafiah et al.).[21] Since most deaths occur decades after infection, hepatitis B and C are projected to become a higher ranked global cause of death over the next two decades – a "viral time-bomb" (WHO).[22] A vaccination for hepatitis B is available and its use is being extended.[23] Hepatitis B and C are suggested to be included, though as a chronic disease which does not allow for a rapid change, it could be addressed in terms of *stabilization* rather than a reduction. Governments should not hesitate in addressing long-term issues, in particular in the context of sustainable development.

Emerging epidemics is a further health issue of importance, similar to those mentioned above. At least 328 000–405 000 people perish per year from *multidrug-resistant (MDR) bacteria,* such as MDR-TB, MRSA or types of E.coli and pneumonia (WHO; ECDC; i.a.).[24] Antimicrobial resistance is also seen in gonorrhoea, influenza and malaria (WHO).[25] New cases of multi-drug resistant tuberculosis (MDR-TB) increased by 65% from 2000 to 2012 (Dye et al.; WHO).[26] Furthermore, there is the risk of a severe *pandemic* occurring. The next pandemic is inevitable (WHO),[27] and a new, mutated or resistant pathogen could trigger a pandemic (Spellberg et al.).[28] Vice versa, the increasing drug-resistance of pathogens could substantially worsen the impact of a pandemic (Morens et al.; WHO).[29] An event similar to the 1918–20 influenza pandemic ("Spanish flu") could at present result in a death toll of between 62 and 360 million (Murray et al.; McKibbin et al.; Taubenberger et al.; Osterholm).[30] Immediate economic

losses from a severe flu pandemic would range from 3.1% to 12.6% of world gross product, averaging 5.57% (Brahmbhatt [WB]; Burns et al. [WB]; CBO; McKibbin et al.).[31] All such risk estimates show high uncertainties, but sustainable development is about the management of future risks and their corresponding uncertainties.

For these reasons it is suggested to consider *a limitation or reduction of new cases and deaths due to multi-drug resistance by 2030 and an enhancement of pandemic preparedness by 2020.*

On ***HIV/AIDS***, even if we achieve ending the spread of incidence by 2030, those already infected will need access to treatment in the run-up to 2030, including antiretroviral treatment. Because antiretrovirals contribute to the prevention of HIV transmission, they will be an important tool to ending HIV/AIDS, but this does not necessarily imply universal access. Therefore the proposed target does not make it superfluous to renew the time-bound MDG target of universal access to treatment. The provision of antiretroviral therapy has been multiplied, reaching 10.6 million people worldwide in 2012, among them 9.7 million people in low- and middle-income countries (UNAIDS).[32] This scale-up of lifesaving treatment is an unprecedented global health effort (Chan [WHO]; WHO et al.).[33] Nevertheless, in low- and middle-income countries antiretroviral treatment in 2012 covered only 34% of those requiring it (UNAIDS).[34] Currently, there is no internationally agreed upon target to provide access to lifesaving treatment beyond 2015.

Hence it is suggested to add the provision of *universal access to treatment* for all those who need it by, e.g., 2020.

According to available mortality data, the above-mentioned proposals are the most important ones in this paper, together with the following suggestions on the proposed target 3.7.

Proposed Target 3.7

"by 2030 substantially reduce the number of deaths and illnesses from air (indoor and outdoor), water and soil pollution"

Depending on how the meaning of "substantially" is interpreted, the proposed target may not offer a change to the current trends. Trend data on the number of deaths from indoor air pollution and drinking water pollution already shows a decrease of 22.2% and 52.9% respectively, between 1990 and 2010. Available data is as follows:

The number of deaths from ***indoor air pollution*** *decreased by 22.2% between 1990 to 2010,* from a figure of approximately 4.47 million to 3.48 million (GBD).[35] According to this trend, a considerable reduction in numbers of deaths can be expected by 2030, without any additional activity. Therefore in order for the target to trigger a positive impact, a *reduction by x%* should be considered for indoor air pollution (x% should be larger than 17% over the 15 year time frame [2015–2030] in order to improve upon the 22.2% reduction seen over the 20 year period [1990–2010]).[36] Alternatively, the target could refer to *improving by x% upon the current trend*.

There is only one increase in current trends regarding this target, which refers to the number of deaths from ***outdoor air pollution***. Numbers of deaths rose from 2.91 million to 3.22 million, or by 10.8%, between 1990 and 2010 (GBD).[37] By 2030, annual deaths from outdoor air pollution in cities alone are projected to increase by 831 000 (OECD).[38] Therefore, to prevent this further increase and to reverse the trend by 2030 would represent an achievement which is substantial, but can also be considered feasible (in comparison to actual achievements on the MDGs, as shown in section 1 above).

If indoor and outdoor air pollution were to be treated as a combined issue, a similar conclusion could be drawn. Since the decrease in deaths from indoor air pollution is bigger than the increase regarding outdoor air pollution, deaths from air pollution altogether would be expected to decrease without any additional activity.

Data on numbers of deaths due to ***soil*** and ***water pollution*** (except for drinking water) is lacking. With regards to unsafe drinking water and sanitation, attributable deaths went down between 1990 and 2010 by an estimated 52.9% (GBD).[39] Deaths from related diarrhoeal disease decreased from 2.49 million in 1990 to 1.45 million in 2010, or by 41.9%, from 1990 to 2010 (GBD).[40] Between 2000 and 2012, the decrease was 31.0% – a high figure for the much shorter time frame (WHO).[41] By 2030, the loss of life due to diarrhoeal diseases is projected to decrease by 10.6%, based on current trends (WHO).[42] Even more than in the case of indoor air pollution, the proposed target would be attained by business as usual. Therefore, a *percentage reduction* should be considered for drinking-water pollution to inspire action, orienting from the latest trends and projections (improving upon 10.6-40% for the 15 year time frame, or improving by x% upon the current trend).

Considering the potential effect on mortality reduction, the proposals above and the previous ones on the proposed target 3.3 are of the most relevance.[43]

Proposed Target 5.6

"ensure universal access to sexual and reproductive health and reproductive rights in accordance with the Programme of Action of the ICPD and the Beijing Platform for Action"

The MDG target of providing ***universal access to sexual and reproductive health*** by 2015 has not seen sufficient progress in order for the deadline to be met. As the SDG proposal continues on from the time-bound MDG target and its unfinished business, a *target year* should be considered. Between 1990 and 2012/13 there was a 28.6% increase in the proportion of deliveries attended by skilled health personnel,[44] and in this time frame, the proportion of women who received antenatal care from skilled health personnel at least once, also increased by 28.6% (UN).[45] The estimated percentage of women who have an unmet need for family planning has been reduced by 19.6% (UN).[46] A deadline is a useful parameter to monitor and promote progress; for example the pace of progress on maternal as well as neonatal deaths accelerated after the time-bound MDG target on maternal health was set (Wang et al.; Kassebaum et al.).[47] Moreover, the MDG target on reproductive health is one of only two such targets which are not proposed to be renewed by a time-bound SDG target in the Zero Draft.

Proposed Target 8.3

"achieve progressively through 2030 global resource efficiency, and endeavour to decouple economic growth from environmental degradation and resource use"

To make the ***use of resources*** more sustainable it would be advisable for the target to mention a minimum increase in resource efficiency. Annual global resource extraction has increased by 63.8% from about 41.6 billion tonnes in 1990 to 68.1 billion tonnes in 2009 (Krausmann et al.).[48] Over the same time frame, material intensity has decreased by 11.8% from 1.53 to 1.35 kg per $ in GDP (dto.).[49] Therefore, gains in resource efficiency were outweighed by a more than 5-times increase in absolute resource extraction. If current trends continue, by 2050 we could see a further increase in resource extraction of 106%, taking the total to approximately 140 billion tonnes (UNEP).[50] The target could refer to *doubling the global rate of improvement in resource efficiency by 2030,* similar to target 7.3 on energy efficiency.

Proposed Targets 8.5 and 8.6

"take immediate and effective measures to secure the prohibition and elimination of the worst forms of child labour, and by 2020 end child labour in all its forms"
"protect the rights and ensure safe and secure working environments of all workers, including migrant workers and those in precarious employment in accordance with ILO norms and standards"

The Zero Draft rightly refers to hazardous child labour as well as to safe and secure working environments, but in terms of a time-bound and quantifiable target it does not refer to the more comprehensive issue of the two: the safety of working environments. ***Occupational diseases and accidents*** claim between 852 000 and 2.34 million lives per year (GBD; WHO; Hämäläinen et al.; ILO).[51] From 1990 to 2010, deaths from occupational diseases and accidents slightly increased by 5.05% (GBD).[52] Approximately 477 million people per year fall sick from an occupational disease or suffer an occupational accident (ILO).[53] They represent 7.1% of the world's population.[54] This issue should not be disregarded in the build-up of a sustainable and inclusive economy.

The topic could be addressed by a target to *reduce deaths from occupational diseases and accidents by x% by 2030* (or to *improve upon current trends by x% by 2030)*. Recalling the ILO standards regarding occupational safety and health without a time-bound target may not be sufficient to improve their implementation and reduce health impacts.

According to available mortality data, the severity of this topic is similar to those of the above-mentioned epidemics or pollution of drinking-water.[55]

Proposed Target 10.5

"improve regulation and monitoring of global financial markets and institutions and strengthen implementation of such regulations"

A time reference could add weight to existing commitments to ***financial stability***. The G-20, the Financial Stability Board (FSB), the Bank for International Settlements (BIS), the International Monetary Fund (IMF), central banks and governments are very active in implementing the regulation proposed after the climax of the global financial crisis in 2008 (IMF).[56] By January 2019, the final step of the Basel III regulation on the capital requirements for banks and other financial institutions will have come into force.[57]

Therefore, without causing any interference to this ongoing process of negotiation and implementation, an *early target year* should be realistic and feasible (e.g. 2020). This could fortify existing commitments to preventing a re-occurrence of the financial crisis,[58] which has exacted and still exacts a detrimental impact on many goals and targets of the international agenda. Increased financial stability would facilitate the proposed SDGs, many of which have a target year of 2030.

Proposed Targets 11.b and 13.a

"by 2020, increase by x% the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resilience, mitigation and adaptation to climate change and natural disasters"
"ensure the fulfilment of the commitment undertaken by developed country Parties to a goal of mobilizing jointly USD100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation"

The Zero Draft recognizes the need for financial and policy-oriented action towards the challenge of ***climate change***, but does not reaffirm targets to control global warming. Global mortality is expected to increase as a result of climate change (IPCC).[59] The changing climate already causes related food insecurity, diseases and disasters which together claim 141 000–400 000 lives per year (WHO; GHF; DARA),[60] projected to increase by 2030 to 632 000 (DARA).[61] There is fear of a further mortality increase if no further action is taken to limit climate change.[62] Although humankind will need growth in mean crop yields, they are expected to decline from 2030 onwards due to extreme climate and weather events by 1% per decade (IPCC).[63] Business as usual will lead to global warming between 3.2° and 5.4° C above pre-industrial levels by 2100 (IPCC),[64] and to projected economic losses ranging from 2.9% to 23% of the gross world product, averaging 7.92% (Nordhaus; Stern; Roson et al.; Kemfert [DIW]; Evans et al.; Ackerman et al.; Kemfert et al. [DIW]).[65] However, keeping global warming below 2.5° C above pre-industrial levels will limit economic losses to 0.2–2% of income (IPCC).[66] The SDG time frame by 2030 will decide on whether global warming can be limited to staying below this temperature level (IPCC; UNEP; IEA; OECD).[67]

For these reasons, it may be advisable to reaffirm – without any interference with the UNFCCC process – the target to maintain the increase in global average temperature at *less than 2° C* (3.6° F) above pre-industrial levels by 2100, as agreed upon by 191 countries in 2010 (UNFCCC).[68]

3 Data Confirming the Selection of Major Topics with Proposed Targets in the Zero Draft

The following diagrams provide an overview of the topics which inflict the biggest impacts to humankind in terms of deaths and economic losses. The same topics can be found in other data showing the biggest impacts in terms of health losses (disability-adjusted life-years, DALYs) and affected natural resources. The diagrams cover only challenges which result from a limited or lack of access to vital resources, such as water or medical treatment.

Available data displayed in the diagrams below gives good reason to keep the time-bound and quantifiable targets proposed for the following topics. These topics have been assessed as belonging to the most important global challenges, and are a result of lack of access to vital resources (such as food, clean air or health care):[69]

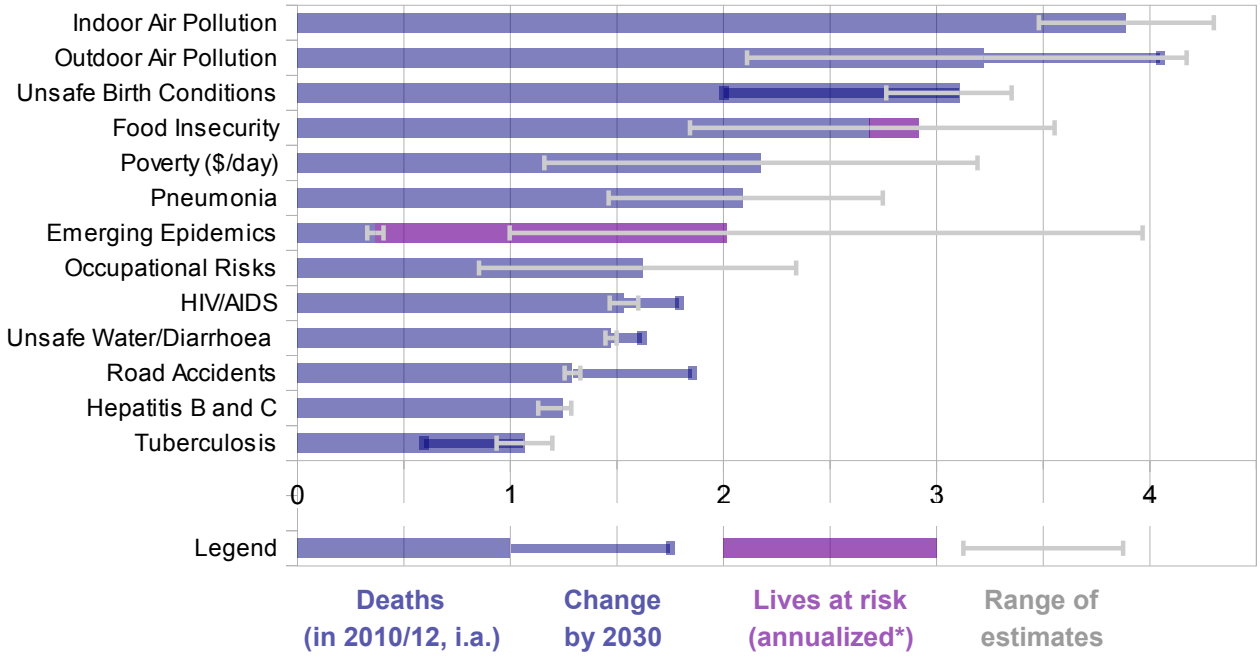
- food insecurity (targets 2.1, 2.2, 12.2)
- unsafe birth conditions (targets 3.1, 3.2)
- indoor air pollution (targets 3.7, 7.1, see comment in section 2 above)
- outdoor air pollution (target 3.7, see section 2)
- climate change (targets 7.2–4, 11.b, 13.a, see section 2)
- pneumonia (no target proposed, see section 2 on target 3.3)
- road accidents (target 3.5)
- financial instability (target 10.5, not time-bound, see section 2)
- poverty in consumption levels ($ per day) (targets 1.1, 1.2)
- biodiversity and ecosystem degradation (targets 14.1–4, 15.2, 15.4)
- occupational diseases and accidents (targets 8.5 and 8.6, see section 2)
- HIV/AIDS (target 3.3)
- unsafe water and diarrhoeal diseases (targets 6.1, 6.2, 11.1)
- unsustainable resource use (targets 8.3, 12.4, see section 2)
- emerging epidemics (no target proposed, see section 2 on target 3.3)
- malaria (target 3.3)
- hepatitis B and C (no target proposed, see section 2 on target 3.3)
- tuberculosis (target 3.3)
- soil degradation (target 15.3).

These targets refer to the topics which have the biggest human impacts (similar to those of the MDG topics) and should be kept as quantifiable and time-bound targets. Poverty, as a in a broad sense, goes beyond consumption levels (expressed in $ per day) and encompasses most, if not all of the topics mentioned above.

Issues Related to Limited Access to Vital Resources (Food, Clean Air, Health-Care, etc.)

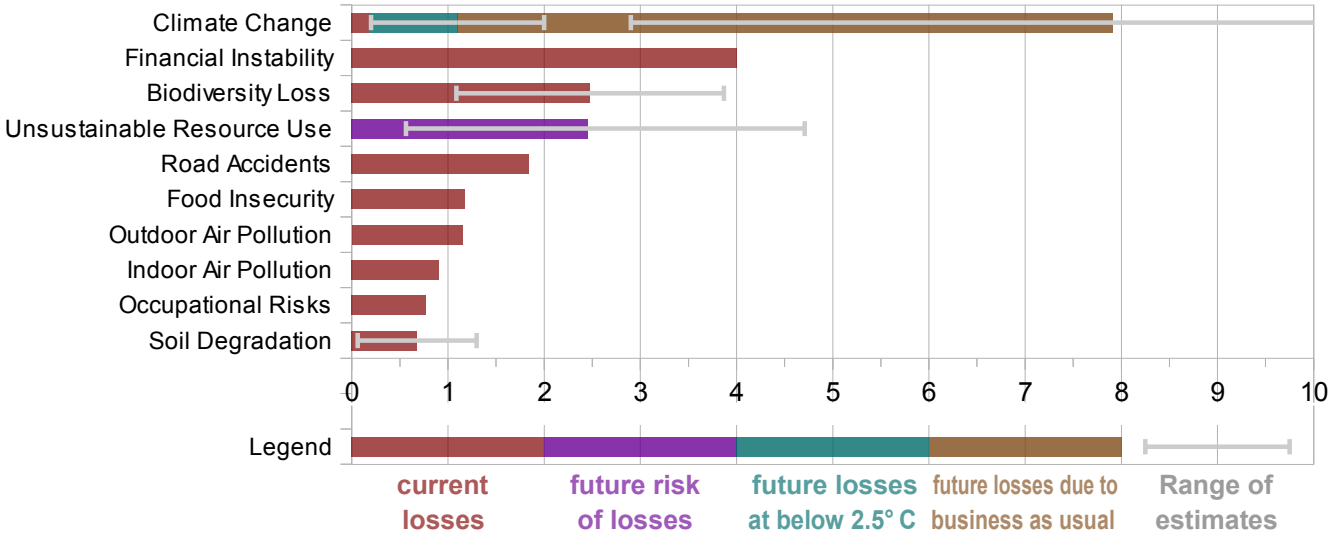
Focus should be given to the magnitude of and large differences between the various impacts.

The Million-Killers Among the Global Challenges (Deaths per Year)



Data sources: GBD 2012; WHO 2014; i.a.[70] Diagram: © Global2015.
* Lives at risk: estimated deaths from risk events (famines, pandemics) divided by frequency of occurrence.

Global Challenges with Biggest Economic Losses per Year (% of GDP)



Data sources: Nordhaus; Stern; Kemfert et al. [DIW]; IPCC; WB; Pimentel; Braat; IMF; WHO; FAO; i.a.[71]
On climate change, future losses at below 2.5° C (above pre-industral levels); future losses which will occur by 2100 if business as usual is continued; on resources, scenarios over 20 years in the case of a decline in oil supply.

Furthermore, there are cross-over topics and topics which can help to address above-mentioned topics:

- cooperation, citizenship and democracy (targets 10.7, 16.3–6, 17.4)
- human rights and gender equality (targets 4.2, 4.5, 5.b, not time-bound, see section 2)
- information and education, research and innovation (targets 4.1, 4.4, 4.b, 7.b, 9.5, 12.c).

Moreover, the gaps and quality issues of available data justify the target 17.15 to improve data capacities in order to identify, tackle and monitor global challenges in an effective and cost-efficient manner.

4 Looking towards the Review "Assessing Priorities for Sustainable Development Goals"

The review will provide a data-based set of major global challenges, which are due to a lack of access to vital resources. It will provide trend data and target achievements since 1990. Available trend data indicates that topics supplied with a target show more improvement than those without a target, and that the MDG targets performed better than other targets agreed upon worldwide by states. There are many topics which are of a severity similar to the MDG topics but have no target so far. Several important topics do not only show insufficient improvement but a worsening trend.

The review will be an update of our proposal "Assessing Priorities for Rio+20" from November 2011, using the latest data and more advanced methods. This update will be released before the next session of the UN General Assembly on the SDGs. The next publication thereafter will also include topic-related human rights standards, recommended activities and interventions, as well as costs and benefits of these measures, as far as is available. Global2015 will continue to monitor developments on the most important global challenges and related target achievements. We will also collaborate with governments, businesses, NGOs and scientific institutions to strengthen action to address the most relevant global challenges.

Annotations

For numeric names the short scale is used:
1 billion = one thousand million = 10^9 = 1 000 000 000
1 trillion = one thousand billion = 10^{12} = 1 000 000 000 000

All numbers are shown to three significant figures, if available (no matter if and where the decimal point may appear). Nevertheless, all calculations are based on unrounded numbers.

All figures in dollars refer to US dollars, unless otherwise stated. To account for inflation, all monetary figures are adjusted to 2012$ (using WB 2013, 'Inflation, GDP deflator (annual %)'; the World Bank deflator was not available for 2013, hence 2013 prices were deflated to 2012$ assuming the same inflation rate as in 2012).

Terms on regions or country groups are used according to the source referred to and are usually specified there.

All percentages of world population are taken from the referred source, or in substitution to that calculated from data provided in WB 2013, according to the respective year.

Almost all available data on global conditions is of low precision. Most data on the largest problems facing mankind are only partially taken from actual measurements of specific cases. More often, estimates are based on modelling and extrapolation. As a result, the data base is far from meeting the motto of the WHO Report 2005:
"Make every mother and every child count".

1 OWG 2014 – see full references in the sources list at p. 25.
2 GBD 2012.
3 WHO 2014; WHO 2014a.
4 A decrease from approximately 3.47 million deaths in 1990 to 1.44 million deaths in 2010 attributable to the risk factor undernutrition, which aggravates the susceptibility to diseases (GBD 2012, pp. 2238); this figure takes into account deaths only in children under the age of five years, hence the total progress may be even higher.
5 Decrease from a peak of 2.3 million [2.1–2.6 million] in 2005 to an estimated 1.6 million [1.4–1.9 million] in 2012 (UNAIDS 2013, p. 4); difference: review's calculation.
6 From 881 000 deaths due to malaria in 2000 (lower and upper bound 670 000 to 1 113 000) to 627 000 (473 000–789 000) in 2012 (WHO 2013e, 62–63); similarly, from 875 000 deaths in 2000 to 618 000 in 2012 (WHO 2014, sheet "Summary", row 29); differences: review's calculations.
7 Inter alia, this has been demonstrated for the decrease in maternal as well as neonatal deaths; Wang et al. 2014, 20, 5 (table 2), 4 (fig. 2); Kassebaum et al. 2014, 21, 5 (fig. 3).
8 OWG 2014, 4–15.
9 ***Pneumonia:*** see fn. 10 below.
HIV/AIDS: 1.47–1.6 million deaths in 2010/12, averaging 1.53 million (GBD; WHO; UNAIDS). Current estimates:
- 1.47 million deaths due to HIV/AIDS in 2010 (95% uncertainty interval 1.33–1.61 million) (GBD 2012, 2105)
- 1.53 million deaths in 2012 (WHO 2014, sheet "Global2012")
- 1.6 million deaths in 2012 (1.4–1.9 million) (UNAIDS 2013, 4).

Mean: review's calculation. The difference between the GBD and UNAIDS figures is mainly due to the adjustment of cause-specific deaths to the estimated total of all deaths in the GBD study (GBD 2012, 2120).
Diarrhoeal diseases (related to unsafe water): 1.45–1.50 million deaths in 2010/12 (GBD; WHO). Latest estimates:
- GBD 2012, 2105 (1.45 million deaths from diarrhoeal diseases in 2010 [95% uncertainty interval 1.28–1.61 million])
- WHO 2014, sheet "Global2012", row 21 (1.50 million deaths from diarrhoeal diseases in 2012).

Data on the risk factor related to safe water released by the latest Global Burden of Disease (GBD) study was not used here since it does not cover the topic of safe water as comprehensively as the previous GBD studies. Risk factors are estimated against a theoretical minimum exposure. This minimum exposure was changed from "Absence of transmission of diarrhoeal disease through water and sanitation" (WHO 2009, 43) to: "All households use an improved water source (household connection, a public tap or standpipe, a tubewell or borehole, a protected well or spring, or rainwater collection)" (GDB 2012, 2227; or the use of improved sanitation facilities, respectively). This change is not consistent with the more comprehensive definitions of minimum exposures of other topics in the latest GBD study, which affects comparability between topics. The new, more narrow scope leads to a lower risk estimate, since not the entire contribution of unsafe water and sanitation to diarrhoeal disease is estimated, but rather only the risk reduction achieved by improved water sources and improved sanitation facilities. These only achieve a reduction of 6–25% or 32% in the risk of transmitting diarrhoeal disease, respectively (Fewtrell et al. 2005, 44, 48; transformation of relative risks into percentages of risk reduction: review's calculations [100 – (relative risk × 100)]). Only 43–89% of improved water sources actually provide safe water (WHO/UNICEF 2011, 35; WHO/UNICEF 2012, 5), and 10% of improved water sources may be contaminated at "high risk" level [with ≥100 E. coli or TTC per 100 ml] (Bain et al. 2014, 1). This is insufficient in the field as well as in a risk analysis. Moreover, the latest GBD study seems to have focussed on "quasi-experimental" research on water treatment at the source (GBD 2012, 2252) which is known to achieve only a risk reduction of 11% (Fewtrell et al. 2005, 44). Additionally, hygiene interventions and disinfection at the point of use were not included (GBD 2012, 2252) which are the most effective measures (28–44% or 35% risk reduction, respectively; Fewtrell et al. 2005, 44, 48; see also fn. 346 below). For these reasons the latest GBD figures on unsafe water have underestimated the risks and are not used in this review. Moreover, also the previous GBD estimates on the risk factor unsafe water, sanitation and hygiene in 2004 have also not been used, instead the latest GBD estimate on diarrhoeal disease in 2010 was preferred in this review in order to draw on the most up-to-date data available.
An underestimation of the numbers of deaths due to unsafe water and sanitation also leads to an underestimation of the reduction of deaths achieved between 1990 and 2010. To avoid drawing such an unrealistically negative picture, only the GBD data on diarrhoeal diseases was shown in the progress diagram on p. 2.
Hepatitis B and C: see fn. 18 below.
Tuberculosis: 935 000 to 1.20 million deaths in 2010/12, averaging 1.07 million (WHO; GBD). Latest estimates:

- WHO 2013 (935 000 deaths in 2012, not including deaths from HIV/AIDS co-infection [WHO 2013f, 43], in accordance with WHO causes of deaths definitions)
- WHO 2013c, 6, 149 (0.94 million deaths in 2012 [95% uncertainty interval 0.79–1.1 million], not including 320 000–336 000 deaths in 2012 from HIV/AIDS co-infection [pp. 6 and xi, fn. 1])
- GBD 2012, 2105 (1.20 million deaths in 2010 [95% uncertainty interval 0.924–1.38 million], not including 257 000 deaths in 2010 [232 000–284 000] from HIV/AIDS co-infection).

Weighted mean: review's calculation, giving the GBD and WHO estimates together the same weight, so 50% for the GBD estimate and 25% for each of the two WHO estimates,
(((935 000 + 940 000) / 2) + 1.20 million) / 2 = 1.07 million.

Malaria: 0.618–1.17 million deaths in 2010/12, averaging 896 000 (WHO; GBD). Current estimates:

- WHO 2014, sheet "Global2012", row 32 (618 000 deaths in 2012)
- WHO 2013e, 1, 61 (table 8.3 b) (627 000 deaths [lower and upper bound: 473 000–789 000] in 2012 [the previous version of the WHO fact sheet did not replace the figure from the WHO World Malaria Report 2012 by the figure in the WHO Global Health Estimates 2013, therefore there are two WHO estimates on malaria])
- GBD 2012, 2105 (1.17 million deaths [95% uncertainty interval 0.917–1.53 million] in 2010).

Weighted mean, weighting the two WHO estimates together to count the same as the GBD estimate: review's calculation, (((618 000 + 627 000) / 2) + 1.17 million) / 2 = 896 000.

The large difference between the WHO and GBD estimates stems from partially different methods: the GBD estimate is based entirely on verbal autopsy (medical interviews in the field), while the WHO estimate is based on, for the most affected countries (and for the largest part of the result) verbal autopsy solely on child mortality (whereas no information is provided on death estimates of individuals from five upwards), and for less affected countries it is based on applying fixed case fatality rates to the estimated number of malaria cases (WHO 2011, 73; WHO 2012, 218; WHO 2013e, 22). The WHO claims that adults in most affected countries should have developed a high level of immune defence and that verbal autopsy leads to overestimation since it cannot differentiate severe malaria from other severe febrile illnesses (WHO 2012, 59 [box 8.2]). The GBD study claims that such overestimation only occurs in situations where malaria is not common; if malaria is common, verbal autopsy tends to underestimate mortality (GBD 2012, 2120). Hence the WHO estimates could be too low and the GBD estimate too high.

Emerging epidemics: see below fn. 24 and 30 (for the latter, figures are divided by 100, assuming a severe pandemic to be a once-in-a-century event).

10 *Child deaths from pneumonia:*

GBD 2012a, Supplementary appendix to Lozano et al., 149–150: 585 000 deaths in children under five in 2010 from the three main types of pneumonia (pneumococcal pneumonia, H influenzae type B pneumonia, and respiratory syncytial virus pneumonia; age groups comprising 0 days to 4 years); the proportion of under-5 deaths among all deaths from the three main types of pneumonia was 40.7% in 2012; sums and percentage: review's calculations.

WHO 2014, sheet "Global2012", row 49, 0-27 days and 1-59 months, male and female (sum: review's calculation): 996 000 deaths in children under five in 2012 due to lower respiratory infections, which are "mainly pneumonia" (WHO 2008, 14, 111). The corresponding proportion of pneumonia is approximately 90% according to personal email communication by Colin D. Mathers, WHO, in August 2011. This equates to about 900 000 child deaths from pneumonia; review's calculation. The proportion of under-5 deaths among all deaths from lower respiratory infections was 32.7% in 2012; percentage: review's calculation (using unrounded numbers).

WHO 2013b: 1.1 million pneumonia deaths in children under five in 2012.

Fischer Walker et al. 2013: 1.3 million pneumonia deaths in children under five. No total deaths estimate given. Referring this figure to the total given by other sources would result in a higher percentage than those percentages calculated for data from the same study only.

Total deaths from pneumonia:

GBD 2012, 2105 (pneumococcal pneumonia: 827 000 deaths [95% uncertainty interval 718 000–900 000], Haemophilus influenzae type B pneumonia: 380 000 [337 000–421 000], respiratory syncytial virus pneumonia: 254 000 [215 000–297 000]); these are the three most common types of pneumonia, corresponding to the three most common infectious agents (WHO 2013b). Further types of pneumonia are only considered under the category "other lower respiratory infections" (which does not include influenza) comprising 846 000 deaths [95% uncertainty interval 734 000–928 000] (GBD 2012, 2105).

Of the *1.46 million* deaths from the three most common types of pneumonia, 585 000 occurred in children under five and 875 000 in individuals aged five upwards (GBD 2012a, Supplementary appendix to Lozano et al., 149–150 [deaths from the 3 main types of pneumonia: pneumococcal pneumonia, H influenzae type B pneumonia, and respiratory syncytial virus pneumonia; age groups comprising 0 days to 4 years, remaining age groups]).

However, on children aged under five substantially higher estimates are also available, which state 1.1 million in 2012 (WHO 2013b) and 1.3 million in 2011 (Fischer Walker et al. 2013). These were combined with the above-mentioned GBD figure on deaths in people from five onwards to reflect all available estimates, resulting in *1.98* and *2.18 million* total deaths, respectively. These figures are still not comprehensive since they do not cover all types of pneumonia in people aged five upwards.

Furthermore, there is an estimate of 3.05 million deaths in 2012 from lower respiratory infections which are "mainly pneumonia" (WHO 2014, sheet "Summary", row 46 [3.05 million]; WHO 2008, 14, 111 [mainly pneumonia]). The corresponding proportion of pneumonia is approximately 90% according to personal email communication by Colin D. Mathers, WHO, in August 2011. This equates to about *2.7 million* pneumonia deaths; review's calculation.

Sums and mean of all four total estimates: review's calculations,

$(1.4607 + 1.975 + 2.175 + (3.05199 \times 0.9)) / 4 = 2.09$.

Data issues on pneumonia may stem from a lot of misdiagnosing and data coding issues of lower respiratory infections (according to WHO experts).

11 GBD 2012a, 149–150 (deaths from the three most common types of pneumonia, pneumococcal pneumonia, H influenzae type B pneumonia and respiratory syncytial virus pneumonia, in 2010 in all age groups from 0–6 days to 1–4 years); sums and percentages: review's calculations.

Similarly, the proportion of under-5 deaths of all deaths due to lower respiratory infections in 2012 was 32.7% (WHO 2014, sheet "Global2012", row 39, age groups 0–27 days and 1–59 months); sums and percentages: review's calculations (using unrounded numbers).

12 From 2.00 million deaths in 1990 to 1.46 million in 2010 (GBD 2012, 2105; on 1990: pneumococcal pneumonia: 858 000 [95% uncertainty interval 779 000–932 000], H influenzae type B pneumonia: 607 000 [542 000–670 000], respiratory syncytial virus pneumonia: 535 000 [463 000–608 000]); sums and percentage: review's calculations.

Between 2000 and 2012, the numbers of deaths from lower respiratory infections (mainly pneumonia) decreased from 3.49 million to 3.05 million, or by 12.6% (WHO 2014, sheets "Global2000" and "Global2012", row 46); percentage: review's calculation.

13 WHO/UNICEF 2009, 3; WHO 2010d (resolution of the World Health Assembly), § 1 (5).

14 WHO 2008, 14, 111.

15 From 1.67 million deaths among children under five in 2000 to 996 000 in 2012 (WHO 2014, sheets "Global2012" and "Global2000", age groups 0-27 days and 1-59 months, male and female); sums and percentage: review's calculations (using unrounded numbers). No data available on the change in incidence since 2000.

16 UNICEF et al. 2006.

17 This calculation assumes a linear pattern of change.

18 WHO 2014e (more than 780 000 deaths every year due to the consequences of hepatitis B) and WHO 2014f (350 000–500 000 deaths each year from liver diseases related to hepatitis C); minimum: review's calculation.

GBD 2012, 2106, 2107 (each in 2010: about 132 200 deaths from acute hepatitis B [95% uncertainty interval 91 100–170 000]; 16 000 [11 600–21 400] deaths from acute hepatitis C; 341 400 [290 000–403 000] from liver cancer secondary to hepatitis B; 195 700 [165 000–222 000] from liver cancer secondary to hepatitis C; 312 400 [271 000–378 000] from cirrhosis of the liver secondary to hepatitis B; and 287 400 [245 000–331 000] from cirrhosis of the liver secondary to hepatitis C); sum (1.29 million): review's calculation.

Mean (used in the diagram): review's calculation,

((780 000 + ((350 000 + 500 000) / 2)) + 1.29 million) / 2 = (1.21 million + 1.29 million) / 2 = 1.25 million.

19 See diagram and fn. 9 above.

20 From 854 000 deaths in 1990 to 1.29 million deaths in 2010 (GBD 2012, 2106, 2107; data on 1990: about 6 8 600 deaths from acute hepatitis B [95% uncertainty interval 46 700–84 400]; 8 100 [4 900–11 600] deaths from acute hepatitis C; 210 000 [177 000–239 000] from liver cancer secondary to hepatitis B; 113 000 [96 600–129 000] from liver cancer secondary to hepatitis C; 242 000 [199 000–271 000] from cirrhosis of the liver secondary to hepatitis B; and 212 000 [181 000–241 000] from cirrhosis of the liver secondary to hepatitis C; data on 2010: see fn. 18 above); sums, difference

and percentage: review's calculations.

21 From 122 million people in 1990 with hepatitis C antibodies to 185 million in 2005 (Mohd Hanafiah et al. 2013; the prevalence rate increased from 2.3% [95% uncertainty level 2.1–2.5%]] to 2.8% [2.6–3.1%], respectively); percentage increase: review's calculation, (1 – (185 / 122)) = 0.516 = 51.6%.

22 WHO 2010a, § 1; referring to hepatitis C.

23 WHO 2014e; the hepatitis B vaccine is available since 1982.

24 No comprehensive data:

- 170 000 people died in 2012 from multidrug-resistant tuberculosis (WHO 2013c, 6; WHO 2013b)
- annually from other infections resistant to multiple drugs:
  - between 23 000 and 100 000 people died in the USA (CDC 2013, 13; Lo Fo Wong [WHO] 2013)
  - 80 000 in China and
  - 30 000 in Thailand (Lo Fo Wong [WHO] 2013)
  - as well as 25 100 people in the EU, Iceland and Norway in 2007 (ECDC et al. 2009, 14, 4).

Sums: review's calculations (no overlap).

25 WHO 2014b (gonorrhoea, influenza); WHO 2007, 23 (malaria).

26 From 273 000 new cases in 2000 (95% uncertainty interval 185 000–414 000) (Dye et al. 2002, 1198; Zignol et al. 2006, 479) to 450 000 (300 000–600 000) in 2012 (WHO 2014h, 49, 43; WHO 2014b); percentage: review's calculation.

27 WHO 2007, xxi, 50 (referring to avian H5N1 influenza).

28 Spellberg et al. 2008, 155.

29 Morens et al. 2008, 2, 7; WHO 2007, 1.

30 Murray et al. 2006, 221, 2214 (62 million [10^{th}-90^{th} percentile range 51–81 million]); McKibbin et al. 2006, 15, 26, 57 (two scenarios; severe: 71.1 million [also used by Burns et al. [WB] 2008, 4]; ultra [without the anomalously high elderly survival rates of the 1918 pandemic]: 142 million); Taubenberger et al. 2006, 15, 21 (>100 million); Osterholm 2005, 1824 (180–360 million); the mean of the 5 estimates is 129 million deaths (review's calculation). A further, less detailed estimate puts the figure at even 2.8 billion deaths (Leggett 2006, 794).

31 Available estimates:

- 3.1% of global GDP (Brahmbhatt [WB] 2006, 10, and WB 2006)
- 3.1% (Burns et al. [WB] 2008, 4)
- 4.25% (CBO 2006, 1, 12)
- 4.8% (severe pandemic; McKibbin et al. 2006, according to Burns et al. [WB] 2008, 3)
- 12.6% (ultra pandemic; McKibbin et al. 2006, 1, 26).

Mean of the 5 estimates: review's calculation.

32 UNAIDS 2013, 46–47.

33 Chan [WHO] 2013; WHO et al. 2013, 13.

34 The percentage of 34% (uncertainty range 32–37%) refers to those who were eligible for antiretroviral treatment in low- and middle-income countries according to the WHO guidelines of 2013; according to the previous guidelines, it was 61% (57–66%) (UNAIDS 2013, 6, 46–47).

35 From around 4.47 million deaths in 1990 (95% uncertainty interval 3.65–5.21 million) to 3.48 million in 2010 (GBD 2012, 2238; considering the GBD data correction on this topic from April 12, 2013).

36 16.7%: review's calculation, (15 years / 20 years) × 22.2% = 0.75 × 22.2% = 16.7%. This proposal assumes a linear pattern of change.

37 GBD 2012, 2238, referring to airborne particulate matter pollution in urban and rural areas in total (95% uncertainty interval regarding 1990: 2.55–3.29 million; 2010: 2.83–3.62 million); percentage: review's calculation (using unrounded figures).

38 From 1.43 million in 2010 to 2.26 million in 2030 (and 3.56 million in 2050); OECD 2012a, sums of OECD, BRIICS and rest of the world; projected deaths due to airborne particles in cities with more than 100 000 inhabitants; sums and percentages: review's calculations. Since this projection refers to urban air pollution only, it may be an underestimation of the total impact.

39 From 716 000 deaths attributable to unimproved water and sanitation in 1990 (95% uncertainty interval 36 800–1.28 million) to 337 000 (13 200–648 000) in 2010 (GBD 2012, 2238).

40 From 2.49 million in 1990 (95% uncertainty interval 2.31–2.66 million) to 1.45 million in 2010 (1.28–1.61 million) (GBD 2012, 2105).

41 From 2.171 million deaths due to diarrhoeal diseases in 2000 to 1.498 million in 2012 (WHO 2014, sheets "Global2000" and "Global2012"); percentage: review's calculation.

42 WHO projection ftom 2013: a decrease from 1.81 million deaths due to diarrhoeal diseases in 2015 to 1.62 million in 2030 (WHO 2013g, sheet "World2030", row 21); percentage: review's calculation (using unrounded numbers). This is a projection on "business as usual" and provides a baseline between "optimistic and pessimistic scenarios" (sheet "Notes"). However, in 2014 the WHO corrected their estimate of current deaths from diarrhoeal diseases downwards from 1.89 million in 2011 to 1.50 million in 2012 (WHO 2013; WHO 2014). Hence, the scale of the projected figures were likely be affected from the according change in methodology and/or underlying data. Therefore only the percentage change was presented here in the main text (which may be less affected or not affected).

43 For comparison, see diagram on the million-killers on p. 10.

44 UN 2013a, Indicator 5.2 (referring to MDG target 5.B), World (56% in 1990); WHO 2014d, 114, 'Births attended by skilled health personnel (%)', global (72% in 2006–13); WHO 2014c, 3, proportion of births attended by skilled personnel, global (72% in 2012); percentage of proportional change: review's calculation,
1 – (72% / 56%) = 0.286 = 28.6%.

45 UN 2013a, Indicator 5.5 (referring to MDG target 5.B), World (from 63% in 1990 to 81% in 2011); WHO 2014d, 114, 'Antenatal care coverage (%)', 'At least 1 visit', global (81% in 2006–13); percentage of proportional change: review's calculation, 1 – (81% / 63%) = 0.286 = 28.6%.

46 UN 2013b, table 'P_Region_Model_UnmetNeed', world, median estimate (related to MDG target 5.B) (from 15.3% in 1990 [95% uncertainty interval 14.1–16.8%] to 12.3% [10.7–14.2%] in 2012); similarly: WHO 2014d, 114 (12% in 2006–13, referring to UN 2013b); the unmet need for family planning is defined as "the percentage of women aged 15 to 49, married or in union, who report the desire to delay or avoid pregnancy but are not using any form of contraception", based on survey data (UN 2013, 32); percentage of proportional change: review's calculation, 1 – (12.3% / 15.3%) = 0.196 = 19.6%.

47 Wang et al. 2014, 20, 5 (table 2), 4 (fig. 2); Kassebaum et al. 2014, 21, 5 (fig. 3).

48 Krausmann et al. 2011, table on material flow data; percentage: review's calculation (using unrounded numbers).

49 Krausmann et al. 2011, table on figure 2.c; similarly, energy intensity decreased by 22.7% from 13.2 to 10.2 MJ/$ in the same time frame (referring to 1990 international dollars; 1 MJ = 1 megajoule = 0.278 kWh); percentages: review's calculations.

50 UNEP 2011, 28, 73; percentage: review's calculation.

51 GBD 2012, 2239 (852 000 deaths from occupational risks in 2010 [95% uncertainty interval 660 000–1.06 million]); WHO 2009, 50 (987 000 deaths from occupational risks in 2004; sum: review's calculation); Hämäläinen et al. 2009, 129 (2.30 million in work-related fatal diseases in 2002 [1.95 million] and fatal accidents in 2003 [356 000]); ILO 2011, 10 (2.34 million in 2008). The large differences between the estimates derive from under-reporting and different but plausible estimation methods.

52 From 811 100 in 1990 (95% uncertainty interval 624 000–1.01 million) to 852 100 in 2010 (GBD 2012, 2239); percentage: review's calculation.

53 About 317 million work-related accidents in 2008 (ILO 2011, 11), and 160 million people suffering from work-related diseases (ILO 2009, 54; ILO 1999; referring to cases of disease contracted as a result of an exposure to risk factors arising from work, for example exposure to asbestos in the workplace); sum: review's calculation (assuming no overlap).

54 Review's calculation from above-mentioned ILO data, using WB 2013: world, 'Population (Total)', 2008.

55 For comparison, see diagram on the million-killers on p. 10.

56 IMF 2013, 47–49.

57 The Basel III target refers to strengthening minimum capital requirements for banks to 8% of total capital asset value by 2013 and in annual steps to 10.5–13% by 2019 (BCBS 2011, 69, 57). The Basel III rules have been endorsed by the G-20 and implemented by the European Commission and other governmental bodies (BIS 2012, 1, 10).

58 G-20 2008, § 2.

59 IPCC 2007a, 791; IPCC 2014, 20: climate change related impacts on human health will increase the risk of injury, disease and death as a direct cause of extreme heat waves, fires and other extreme weather events (very high confidence) as well as a result of increased risks of water- and food-borne diseases (very high confidence) and vector-borne diseases (medium confidence) and under-nutrition resulting from decreased food production (high confidence).

60 Most recent estimates:

- WHO 2009, 50 (141 000 in 2004) (similar: WHO 2013d [over 140 000])
- GHF 2009, 1, 3, 11, 30, 84–90 (315 000 annually in 2004–08)
- DARA 2012, 17 (400 000 in 2010). .

61 Approximately 380 000 projected climate-related deaths due to hunger, 150 000 from diarrhoeal infections, 40 000 from meningitis, 35 000 from heat and cold illnesses, 20 000 from malaria and other vector-borne diseases, and 7 000 from environmental disasters (DARA 2012, 17); sum: review's calculation.

62 Christian Aid 2006, 9.

63 IPCC 2014b, 3, 22 (medium confidence; likelihood 66–100% [IPCC 2014, 4 (fn. 2)]).

64 IPCC 2013, 20 (scenario RCP8.5 [see fn. 69 below]), 19 (0.61°C difference between the averages of the periods 1850–1900 and 1986–2005).

65 Business-as-usual scenarios for 2100 (the year for which the most projections are available), including non-market impacts and referring to 2.6–4.8° C above 1986–2005 levels (or 3.2–5.4° C above 1850–1900 levels, which are close to pre-industrial levels) in 2100 according to the scenarios in IPCC 2013, 20 (scenario RCP8.5 [see fn. 69 below]), 19 (0.61°C difference between the averages of the periods 1850–1900 and 1986–2005), and WB 2012d, 23–24:

- Nordhaus 2008, 13, 181 (*2.9%* in losses of global GDP at 3.1° C above pre-industrial levels in 2100; included because the projected temperature level is very close to the range suggested by the IPCC)
- Stern 2006, 156–159 (*2.9%* at 4.3° C in 2100 and for high climate sensitivity, *5.9%* at 3.5° C)
- Roson et al. 2012, 11, 15 (*4.6%* at approximately 5.5° C [4.9° C above 2000 levels] in 2100; also cited in Tol 2013, 11 [table 1]; included because the projected temperature level is very close to the range suggested by the IPCC)
- Kemfert [DIW] 2005, 135, 139, 140 (*6.40%* or $15.4 trillion at 3.5° C in 2100 with no policies by 2025, *8.33%* or $20 trillion at 4.3° C in 2100 with no policies by 2100 [second temperature level taken from figure 3 (p. 139); percentages: review's calculations from the data provided ($12 trillion equal to around 5% of the projected global GDP [p.140], (5 / 12) × 15.4 = 6.40% (first percentage), (5 / 12) × 20 = 8.33% (second percentage)])
- Evans et al. 2009, 22 (*6.4%* at 3.9° C in 2100, considering catastrophe risks and increased damages)
- Ackerman et al. 2008, 10, abstract (*10.8%* in 2100; no temperature level provided, but referring to a high climate sensitivity and therefore high global warming [similar to Stern 2006])
- Kemfert et al. [DIW] 2005, 35–38, 31, 32 (*23%* at 4.3° C in 2100, considering feedbacks with trade and investment, and ancillary costs due to air pollution; also in OECD 2008, 281).

Mean of these 9 projections and percentage: review's calculation (using unrounded numbers). Since the purpose of the indicator is not a cost-benefit analysis, no discounting was applied to future losses (see WB 2010, 49).

The current and future losses mentioned above do not include the recent estimates by DARA 2012 and Tol [CC] 2011 for the following reasons. The DARA 2012 estimate and projection on 2030 is very detailed but provides little reasoning for its figures – these could also be seen as an overestimation if the small temperature increase expected by 2030 is taken into account. The opposite may apply to the Tol [CC] 2011 estimate and projection, which are based on a projected 3.4° C temperature level in 2100, but this level may not refer to pre-industrial levels and is only approximately 1.6° C above the average 20st century's level modelled by Tol and therefore does not meet the inclusion criteria derived from the IPCC mentioned above (2.6° C above pre-industrial levels or 2.1° C above 1980–99 levels) (Tol [CC] 2011, 7 [fig. 1]; the temperature increase projected for 2100 is 3.4° C [with no reference point defined], but the mean for the values 1900–1995 [as read from the diagram] is approximately 1.8° C, and the difference is only 1.6° C; similarly, if the 0° C level of the diagram were to refer to pre-industrial temperature levels, the 20st century's level would be substantially overestimated, with an average 2.3° C in 1980–95 instead of 0.61° C in 1986–2005 (above pre-industrial levels); means and difference: review's calculations). The assumed low warming from the 20st century to 2100 would lead to overestimate past and present impacts and/or to underestimate future losses relative to past and present impacts (creating an artificially optimistic picture of the future). Compared to empirical data on the global temperature change during the 20st century, the simulation by Tol's FUND model shows a threefold variation in temperature, higher relative temperature levels from 1915 to 1930 and, most importantly, a much smaller overall increase in temperature (comparing Tol [CC] 2011 to IPCC 2013, 6 [fig. A]). Furthermore, the Tol [CC] 2011 projection does not make explicit in which way societal costs (e.g. what kind of health-related costs) were included.

66 IPCC 2014a, 4, and IPCC 2014, 19 (±1 standard deviation around the mean; medium evidence, medium agreement); according to personal email communication by Eric Kissel (IPCC WG2 TSU), the "additional temperature increases of ~2°C" in the summary (IPCC 2014, 19) refers to 1986–2005 levels and the "global mean average temperature rise of 2.5C" in the

report chapter (IPCC 2014a, 4) to pre-industrial levels. "Losses are more likely than not to be greater, rather than smaller than this range (limited evidence, high agreement)" (IPCC 2014, 19). This projection has not been included in the diagram on economic losses (since it is not based on current trends and policies, and the year of occurrence is not specified).
For a global warming of up to 2.5° C above pre-industrial levels, there are many projections within the economic losses range given by the IPCC, but one projection below it (Mendelsohn et al. 2000, 46, taking into account market impacts only) and two projections above it (Evans et al. 2009, 21; Kemfert et al. [DIW] 2005, 41). Scenarios on an exact 2.0° C increase above pre-industrial levels range from 1.0 to 1.41% in losses of global GDP, including market and non-market impacts (Nordhaus et al. 2000 [taken from fig. 20.3a in IPCC 2007a, 822]; Kemfert [DIW] 2005, 139–140 [$3.39 trillion by 2100; percentage: review's calculation from the data provided ($12 trillion equal to around 5% of the global GDP [p. 140]), (5 / 12) × 3.39 = 1.41%]).

67 IPCC 2013a, 57–58; IPCC 2007b, 5, 12; IPCC 2007a, 213; IPCC 2007c, 774–775; UNEP 2013, xiii; IEA 2012, 1; IEA 2013, 2; OECD 2012, 3.

68 UNFCCC 2010, § 1 (4). This date has been assumed from the context, as the two degree target was proposed by the IPCC, and refers to 2100.

69 The selection and order of topics is derived from a composite indicator which uses the single indicators displayed in the diagrams above. The single indicators are combined according to their overall ratio to the DALY indicator (disability-adjusted life-years; data mainly from GBD 2012 and WHO 2012; not presented in this proposal). Results and methodological details will be provided in the full review on "Assessing Priorities for Sustainable Development Goals" by Global2015.

70 ***Indoor air pollution:*** GBD 2012, 2238 (3.48 million deaths in 2010 attributable to household air pollution from solid fuels [uncertainty interval 2.64–4.39 million]; considering the GBD data correction on this topic from April 12, 2013) (also referred to in SE4ALL 2013, 103, 104); WHO 2014j, 1, and WHO 2014k (4.3 million deaths in 2012 attributable to air pollution in households cooking over coal, wood and biomass stoves; the joint effects of indoor and outdoor air pollution are estimated at 7 million deaths in 2012 [WHO 2014l, 1 (p. 7 in the PDF file)]).

Outdoor air pollution from airborne particles and ground-level ozone:

- Silva et al. 2013, 6 (table 1) and 8 (2.11 million [95% uncertainty interval 1.3–3.0 million] deaths from cardiopulmonary diseases (93%) and lung cancer (7%) attributable to anthropogenic $PM_{2.5}$ [particulate matter less than 2.5 micrometres in diameter], 472 000 deaths [95% uncertainty interval 140 000–900 000] attributable to anthropogenic ozone [O_3])
- GBD 2012, 2238 (3.22 million deaths attributable to ambient particulate matter pollution [95% uncertainty interval 2.83–3.62 million] and 152 000 deaths attributable to ambient ozone pollution [52 300–267 000] in 2010)
- WHO 2014i, 1, and WHO 2014g (3.7 million deaths attributable to ambient air pollution in 2012, due to exposure to particulate matter of 10 microns or less in diameter [PM_{10}] [according to data provided in a diagram, the figure is 3.73 million (WHO 2014i, 1 [fig. 1]; sum: review's calculation); the joint effects of indoor and outdoor air pollution are estimated to cause 7 million deaths in 2012 [WHO 2014l, 1 (p. 7 in the PDF file)]).

All estimates include urban and rural air pollution; ground-level ozone (or tropospheric ozone) is formed in the air by other pollutants such as hydrocarbons and nitrogen oxides; sums and means: review's calculations (considering possible overlaps between different risk factors, but assuming no overlaps between deaths from different diseases attributable to the same risk factor; for the maximum, only the highest figure on deaths due to ground-level ozone [472 000] was added to the WHO estimate, which refers to particulate matter only; for the mean, the range of deaths due to ground-level ozone [152 000–472 000] was added to the WHO estimate).
Projection on 2030: increase by 0.831 million deaths until 2030; deaths from urban air pollution due to airborne particles in cities with above 100 000 inhabitants, increasing from 1.43 million in 2010 to 2.26 million in 2030 (OECD 2012b, sum of OECD, BRIICS and rest of the world; diagrams and explanations: OECD 2012, 286–287); sums and difference: review's calculation.

Unsafe birth conditions: 2.76–3.35 million deaths per year, comprising neonatal and maternal conditions:

- WHO 2014, sheet "Global2012", row 53 (2.48 million neonatal deaths in 2012 [deaths due to neonatal conditions within the first 28 days]).
- Wang et al. 2014, 1, 5 (table 2) (2.61 million in 2013 [2.00 million early neonatal (0–6 days) deaths (95% uncertainty interval 1.92–2.08 million) and 0.611 (0.579–0.646) million late neonatal (7–28 days) deaths; sum: review's calculation]; this estimate of 2014 stems from the team of the GBD study and is considered in this review to replace the estimate by GBD 2012, 2106).

- UNICEF 2013, 50, World (2.85 million neonatal deaths in 2012).
- WHO 2013a, 14 (3.0 million neonatal deaths in 2011).
- UNFPA et al. 2012, 16 (3.06 million neonatal deaths in 2012, category "2012 contraceptive use", which describes the current conditions).
- WHO et al. 2014, 1, 25 [table 4], 26 (289 000 maternal deaths in 2013)
- Kassebaum et al. 2014, 2, 6 (table 1), 14 (293 000 maternal deaths in 2013 [95% uncertainty interval 261 000–328 000]; this estimate from 2014 stems from the team of the GBD study and is considered in this review to replace the estimate by GBD 2012, 2106)
- WHO 2014, sheet "Global2012", row 52 (296 000 maternal deaths in 2012).

Projections on deaths in 2030: approximately 1.7–1.91 million newborns and 184 000–201 000 women; sources:

- Wang et al. 2014, 15–17 (1.7 million neonatal deaths in 2030, derived from 44.9% neonatal deaths [p. 17] among all 3.8 million under-5 deaths in 2030 [p. 16] expected if country-level rates of change do not accelerate; absolute figure: review's calculation, 44.9% × 3.8 million = 1.71 million). If country-level rates of change assume the rate of the fastest improving 95th percentile of countries, total child mortality is expected to decrease to 2.4 million by 2030 (instead of 3.8 million) (p. 16, 17 [fig. 6]). This would further reduce neonatal deaths.
- Kassebaum et al. 2014, 19 (184 000 maternal deaths in 2030 [95% uncertainty interval 134 000–245 000], a "fairly optimistic forecast scenario").
- WHO 2013g, sheet "World 2030", rows 52 and 53 (1.91 million neonatal and 201 000 maternal deaths in 2030).

Food insecurity: at least 1.84–3.55 million deaths per year. The available mortality figures consider two groups: children under the age of five (mortality due to undernutrition as a risk factor for direct causes of death) and individuals aged five years or over (mortality directly caused by nutritional deficiencies; which is much less comprehensive than data on all mortality due to undernutrition as a risk factor):

a) On children aged' under five:

- approximately 1.44 million deaths attributable to child and maternal undernutrition in 2010 (95% uncertainty interval 1.18–1.71 million) (GBD 2012, 2238 [joint effects of childhood underweight, suboptimal breastfeeding, and vitamin A, iron and zinc deficiencies])
- 3.10–3.15 million deaths under five attributable to child and maternal undernutrition in 2011 (Black et al. 2013, 433 [UN-based and NIMS-based figures], 442 [joint effects of stunting, wasting, fetal growth restriction, suboptimum breastfeeding, and vitamin A and zinc deficiencies] [this figure is also cited in UNICEF 2013, 27]).

Neither estimate considered neonatal vitamin A deficiency (in the first month of life) or insufficient dietary folic acid (GBD 2012, 2252; Black et al. 2013, 441, 444, 433). The lower estimate did not consider intrauterine growth restriction (low birthweight) (GBD 2012, 2255) – which accounts for 0.817 million deaths in the upper estimate (Black et al. 2013, 433). The upper estimate excluded deaths attributable to vitamin A deficiency not only in the first month, but in the first six months of life (Black et al. 2013, 441). Iron deficiency in mothers contributing to low birthweight and related mortality is also covered, but it was assessed not to lead to death itself in children – both unlike in the lower estimate (Black et al. 2013, 427, 431, 439; GBD 2012, 2238, 2243). For indicators on undernutrition, the two estimates chose between using underweight or using stunting and wasting. The lower estimate included the 0.860 million deaths from childhood underweight in 2010, but excluded the 0.9 million deaths from childhood stunting and the 0.7 million deaths from childhood wasting (the two figures cannot simply be added, due to overlap) (GBD 2012, 2253, 2238). The upper estimate was created the opposite way, including the 1.02 million deaths from stunting and 0.875 million deaths from wasting (compensating for overlap), but excluding the 0.999 million deaths from underweight (Black et al. 2013, 433, 442, 444). This choice of indicators marks the biggest difference between the two estimates, besides the exclusion of low birthweight from the lower estimate. Particularly because of this exclusion, and the exclusions made in both estimates, the lower estimate appears to be more likely an underestimate than the upper estimate an overestimate.

b) On individuals aged five years or over, data is only available on nutritional deficiencies as a direct cause of death. This does not include mortality from diseases attributable to undernutrition as a risk factor. Among all deaths caused by nutritional deficiencies (approximately 684 000 in 2010 [95% uncertainty interval 546 000–790 000]),280 000 occurred in children under five and 404 000 in adults and children from five onwards (GBD 2012, 2106, and appendix GBD 2012a, 151; sums and difference: review's calculation). The latter figure (404 000) was added to the above-mentioned under-5 deaths due to undernutrition (sums and mean: review's calculation). However, that figure does not consider all mortality due to undernutrition among individuals from the age of five upwards. In children under five, the number of above-mentioned

deaths due to the risk factor undernutrition is several times the number of deaths due to nutritional deficiencies (1.44 million compared to 280 000). Therefore the total mortality due to undernutrition in people aged five or over is likely underestimated here. – Similar data on deaths related to nutritional deficiencies is also available from WHO (in 2011: approximately 619 000 deaths, of which 204 000 occurred in children under five and 415 000 in adults and children from five on; WHO 2013; sums and difference: review's calculation). For consistency reasons, the latter figure (415 000) was not considered for the total number of deaths. Instead, the figure from the GBD study (404 000) was used.

Poverty in consumption levels: 1.16–3.19 million deaths per year, derived as follows: Income poverty below $2 per day has strong associations with

- inadequate water and/or sanitation (36%-51%)
- indoor air pollution (33–50%) and
- underweight children (23–37%) (Blakely et al. [WHO] 2004, 1942, 2068–2069 [36–51%, 1/3–1/2, and 23–37%, respectively]; WHO 2002, 51 [51%, 50% and 37%, respectively]).

This data describes how the risk percentage for people who have a daily income below 2$ would be reduced if they had the same risk factor prevalence as people living on more than 2$ per day. Referring to current mortality data on these issues, this equals an approximate 1.16–3.19 million deaths annually, attributable to consumption level poverty (likely to be an underestimate due to incompleteness); review's calculations using GBD 2012, 2238, Black et al. 2013 and WHO 2014. Corresponding figures:

- On unsafe water and sanitation, for consistency the estimate from the same study cited in the poverty research was used (88% of all diarrhoeal diseases; Prüss-Üstün et al. [WHO] 2004, 1322) and applied to the latest estimates on diarrhoeal diseases (upper estimate: 1.50 million deaths in 2012 [WHO 2014, sheet "Global2012", row 21]; lower estimate: 1.45 million deaths in 2010 [95% uncertainty interval 1.28 to 1.60 million; GBD 2012, 2105]; the estimate on unimproved water and sanitation of GBD 2012, 2241, 2252, seems to follow a more narrow concept than Blakely et al. [WHO] 2004 and also seems to prefer studies which apply restrictive assumptions, possibly leading to an underestimate; see section on diarrhoeal diseases in fn. 9).
- 3.48–4.3 million deaths in 2010/2013 were attributable to household air pollution from solid fuels (GBD 2012, 2238; WHO 2014k).
- Underweight in children aged under five represents only a part of child undernutrition and claimed 860 000 to 999 000 lives in 2010/11 (GBD 2012, 2238 [860 000 in 2010, 95% uncertainty interval 716 000 to 1.03 million]; Black et al. 2013, 433, 444 [999 000 in 2011]).

Review's calculations of minimum (considering possible overlaps): 0.33 × 3.48 million = 1.16 million (regarding poverty-related indoor air pollution only, since this results in the highest single factor, assuming complete overlap); maximum (assuming no overlap): (0.51 × 0.88 × 1.50 million) + (0.50 × 4.3 million) + (0.37 × 999 000) = 3.19 million. This range of figures was calculated for the purpose of replacing missing data only and should not be used or quoted for other purposes, due to its uncertainties.

Pneumonia: see fn. 10 above.

Emerging epidemics: see fn. 24 and 30 above (for the latter, figures are divided by 100, assuming a severe pandemic to be a once-in-a-century event).

Occupational diseases and accidents: see fn. 51 above.

HIV/AIDS: current deaths: see fn. 9 above; projection: 1.79 million deaths in 2030 (WHO 2013g, sheet "World2030" [based on projections by the UN Population Division and UNAIDS]).

Diarrhoeal diseases/unsafe water: current deaths: see section on diarrhoeal diseases in fn. 9 above; projection: 1.62 million in 2030 (WHO 2013g, sheet "World2030", row 21 [projection on business as usual]).

Road accidents: 1.25–1.33 million deaths in 2010/12 (WHO 2014, sheet "Global2012", row 157 [1.25 million deaths due to road injury in 2012]; GBD 2012, 2109 [1.33 million deaths in 2010; also WB et al. 2014, 23]).

Projection: 1.85 million deaths in 2030 (WHO 2013g, sheet "World2030", row 157); projection on business as usual.

Hepatitis B and C: see fn. 18 above.

Tuberculosis: current deaths: see section on tuberculosis in fn. 9 above; projection: 595 000 deaths in 2030 (WHO 2013x, sheet "World2030" [projection on business as usual]).

In some cases there were two estimates by the WHO; then a weighted mean was calculated, giving the two WHO estimates together the same weight as each other estimate; review's calculations.

71 ***Climate change:***

- Current losses: US$137 billion (0.189% of global GDP); GHF 2009, 92 ($126 billion in 2010 [90% confidence interval $4.1–951 billion], presumably in 2010$; adjusted to 2012$ using WB 2013, World: 'Inflation, GDP deflator (annual %)'); percentage: review's calculations using WB 2013, World: 'GDP (current US$)', 2012.
- Future losses at below 2.5° C: 0.2–2% of global income if global warming is kept below 2.5° C above pre-industrial levels; IPCC 2014a, 4, and IPCC 2014, 19 (see details at fn. 66 above); it needs to be emphasized that this estimate assumes strong efforts to curb global warming, including "negative emissions" through reafforestation, etc.; therefore much higher losses are already locked in.
- Future losses in 2100 in the case of business as usual: 2.9–23% of global GDP in 2100 (averaging 7.92%); see fn. 65 above (Nordhaus 2008; Stern 2006; Roson et al. 2012; Kemfert [DIW] 2005; Evans et al. 2009; Ackerman et al. 2008; Kemfert et al. [DIW]).

Financial instability: approximately 4.00% of global GDP in losses. The annual global average growth rate of real GDP from 1991 to 2007 was 2.96%, and over 2008–11 and 2008–12 it averaged at 1.54% and 1.70%, respectively. This accounts for 1.42% and 1.26% less annual growth, respectively (calculated with unrounded numbers). Figures for both periods, 2008–11 and 2008–12, are given as it is not clear so far whether the 2012 figure represents a second trough year within that time frame. The period 1991–2007 was chosen to serve as a long-term measurement of comparison, to cover several full periods or patterns of minimum and maximum annual growth rates (similar to business cycles), to provide a middle ground in estimating the long-term rate and level of GDP growth, and to compensate for the strong growth in the years before the crisis which is often considered bubble growth. From the average growth rate of the 1991–2007 period, a pre-crisis trend of GDP up until 2012 was calculated. To prevent the starting year from influencing the level of calculated GDP, the GDP level was adjusted to an average level derived from the 2001–2007 period (from each year of this period onwards, a trend based on the average growth rate 1991–2007 was calculated, and from the resulting 2007 GDP levels the average was taken as the starting point for the reference trend up until 2012; this averaging leads to a lower losses estimate [also in comparison to simply taking the 2007 or 2008 GDP as the starting point]). Actual GDP in 2012 was 3.91% below the GDP expected from the pre-crisis trend. Data: WB 2013, 'GDP growth (annual %)' (based on constant 2005 US Dollars) and 'GDP (constant 2005 US$)' (both already adjusted for inflation); means, trend and percentages: review's calculations.

Additionally, fiscal losses of $1.40 trillion were incurred due to banking crises, currency crises and sovereign debt crises in less developed countries, divided by 23 years, equalling $66.6 billion or 0.0920% of global GDP per year (WB 2014: $1 trillion amounting from 1980 to 2002 [years taken from the diagram], presumably in 2005$; adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)'); division and percentage: review's calculations (using WB 2013, world: GDP in current US$).

The two losses amount to 4.00% of gross world product (assuming the second type of losses persisted); sum: review's calculation using WB 2013, World: GDP (in current US$), 2012.

Biodiversity and ecosystems degradation: $810 billion to $2.83 trillion lost per year (1.12–3.90% of global GDP), comprising of:

- $634 billion to $2.64 trillion per year due to invasive species (Pimentel et al. 2001, 14: $336 billion in six large countries of different income levels, extrapolated to $1.4 trillion globally, presumably in 1998$ [since referring to 1998 GNP]; adjusted to 2012$ using WB 2013, 'Inflation, GDP deflator (annual %)' for the USA, the UK, Australia, South Africa, India and Brazil; adjustments for inflation and resulting sums: review's calculations)
- $75 billion per year due to underperforming fish stocks (WB 2009, 41: $51 billion in 2004 [80% confidence level $37–67 billion], presumably in 2004$; adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)')
- $86 billion per year in lost services from land-based ecosystems, not considering invasive species (Braat et al.[TEEB] 2008, 11, 136: €50 billion in 2000 (annual cost continuing in 2050, including direct and indirect impacts on GDP: actual costs, income foregone and welfare costs [p.121]), in 2007€ [p. 122]; converted to $68.6 billion (in 2007$) using FRB 2011 and adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)')
- $15.5–23.3 billion per year due to illegal logging (WB 2004, 1: $10–15 billion, presumably in 2003$; adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)').

Unsustainable resource use: 1.13–9.42% of annual global GDP (averaging 4.91%) at risk within 20 years; IMF 2011, 102–109: four scenarios on oil scarcity:

- decrease of annual GDP by 2.90% in the benchmark scenario (IMF 2011a, Real GDP, year 20)
- 1.13% decrease in the alternative scenario 1: greater substitution away from oil (IMF 2011b, Real GDP Upside scen-

ario, year 20)
- 9.42% decrease in the alternative scenario 2: greater decline in oil production (IMF 2011c, Real GDP Downside scenario, year 20)
- 6.20% decrease in the alternative scenario 3: greater economic role for oil (IMF 2011d, Real GDP Downside scenario, year 20); no estimates on the probabilities of occurrence for the scenarios available.

Road accidents: $1.33 trillion in losses per year (1.84% of global GDP), according to WHO 2004, 15–16 (derived from TRL 2000, 11 [latest available data], see also WHO 2009d, 2), losses from road accidents comprise about 2% of gross national income (GNI, formerly GNP) in high-income countries, 1.5% of GNI in middle-income countries and 1% of GNI in low-income countries; review's calculation using the following figures from WB 2013, GNI (current US$), 2012:
($49.9 trillion in GNI × 0.02) + ($21.9 trillion × 0.015) + ($0.512 trillion × 0.01) = $1.33 trillion (in 2012$).
The percentage of total GNI is almost the same as in WHO 2004, 15 (table 5); percentage: review's calculation using WB 2013, GDP (current US$), World, 2012.

Food insecurity: $852 billion (1.18% of global GDP) per year in food losses and waste (FAO 2013, 55; $750 billion lost in 2007, expressed in 2009 producer prices of about 180 agricultural products in more than 100 countries (excluding fish and seafood); adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)'); percentage: review's calculation using WB 2013, World: 'GDP (current US$)', 2012.

Outdoor air pollution: 1.15% of global GDP in 2010. This is the low estimate according to the data and methodology used in Hutton [CC] 2011:

- The estimated losses include premature mortality, building and other material damage, heath care costs, productivity losses from morbidity, natural resources and crop damage, and visibility damage resulting from anthropogenic outdoor air pollution (Hutton [CC] 2011, 7, 13, 28 [figure 18], 29 [figure 19]).
- Mortality is the main factor in this estimate and related economic losses are calculated in a way which is not directly comparable to most estimates on other topics used in this review. The estimate is based on the willingness-to-pay approach which usually results in much higher figures than deriving productivity losses from lost years of life. Since most estimates on mortality-related economic losses in this review use the latter method, comparison between topics would be affected by using an estimate based on the other method.

For this reason, this review uses the low estimate outlined by Hutton which is much closer to an estimate derived from productivity losses. Hutton uses for the baseline estimate a "value of statistical life" of $3 million in developed countries and $685 000 in less developed countries, reflecting different income levels (in 1990$; p. 14–15, 31). For the low estimate, the figures are $1 million and $228 560, respectively (p. 15, 21). Correspondingly, Hutton provided different figures on economic losses due to air pollution (outdoor and indoor pollution combined), a baseline estimate of 5.4% of gross world product in 2010 and a low estimate of 2.1% (p. 31).

Such a figure is not provided for outdoor air pollution solely, but can be derived from the data provided as follows. The baseline estimate for outdoor air pollution is 2.7% of global GDP (2010) (p. 22 [table 6]). Mortality accounts for approximately 86% of these (p. 28 [fig. 18], 29 [fig. 19], read from the diagrams). This proportion can be changed according to the ratio between the low and the baseline value of statistical life (1/3). Then, the changed mortality-related proportion can be combined again with the (unchanged) losses not related to mortality (the remaining 14%). The review's calculation is as follows:
(2.7% × 86% × 1 / 3) + (2.7% × 14%) = (2.7% × 0.86 / 3) + (2.7% × 0.14) = 0.774% + 0.378% = 1.15%.
For 2050 and with no change in policy trends, the same percentage of gross world product is projected to be lost (p. 22 [table 6]).

By using economic losses data this proposal in no way suggests the value of a human life is limited to economic dimensions nor that it is of a different value in different world regions.

Other available data on economic losses due to outdoor air pollution is not as comprehensive (and was therefore not used for the composite indicator):

- in the USA, $91.7 billion from air pollution (Muller et al. 2007, 11, 8 [$74.3 billion in the USA in 2002 (range between $71 billion and $277 billion), presumably in 2002$; adjusted to 2012$ using WB 2013, USA: 'Inflation, GDP deflator (annual %)'])
- in China, $28.9 billion from air pollution (WB et al. 2007, 74–75 [5th %ile: 74.9 billion Yuan, 95th %ile: 231.8 billion Yuan, mean: 153 billion Yuan in China in 2003, presumably in 2003 Yuan; converted and adjusted to 2012$ using PBC 2009, "Yuan per US Dollar (Period Average)" (annual mean of monthly data: review's calculation), and WB 2013,

China: 'Inflation, GDP deflator (annual %)'; for consistency within this review, the estimate according to the adjusted human capital approach, which is based on losses of healthy life-years, was chosen])

- globally, $22.7 billion due to reduced agricultural yields as a result of exposure to ground-level ozone (which is not considered in the estimates above) (HTAP 2010 [$14–26 billion, presumably in 2009$; inflated to 2012$ (15.4–28.6 billion) using WB 2013, world: 'Inflation, GDP deflator (annual %)'; mean: review's calculation).

Occupational diseased and accidents: $557 billion in annual losses (0.769% of global GDP), comprising:

- approximately $270 billion in the USA (Leigh 2011, 728, 740: $250 billion in 2007, in 2007$ [p. 744]; adjusted to 2012$ using WB 2013, USA, 'Inflation, GDP deflator (annual %)')
- $287 billion in 14 EU countries (EU-OSHA 1998, 31: ECU143 billion, in 1995ECU [p. 30]; sum: review's calculation; converted to US$185 billion using NBH 2013, annual average, and adjusted to 2012$ using WB 2013, EU, 'Inflation, GDP deflator (annual %)').

Sums and percentage: review's calculations (using WB 2013, World: 'GDP (current US$)', 2012).

Indoor air pollution: 1.29% of gross world product in 2010. This is the low estimate according to the data and methodology used in Hutton [CC] 2011 (see the section above on outdoor air pollution within this footnote). The baseline estimate for indoor air pollution is 2.9% of global GDP in 2010 (p. 22 [table 6]). Mortality accounts for approximately 83.1% of these (86% in less developed countries [p. 30 (fig. 21)] and only 32% in developed countries [29 (fig. 20, both figures taken from the diagrams)]; however, developed countries contributed only 5.6% to the losses in 2010 [share of total cost in %, p. 22 (table 6)], so the resulting weighted mean is 83.1% [(86% + (32% × 5.6%)) / (100% + 5.6%) = (86% + (32% × 0.056)) / (1 + 0.056) = 83.1%]; review's calculation). The mortality-related proportion can be changed according to the ratio between the low and the baseline value of a statistical life (1/3). Then, the changed mortality-related proportion can be combined again with the (unchanged) losses not related to mortality (the remaining 16.9%) by adding these together. The review's calculation is as follows:

(2.9% × 83.1% × (1 / 3)) + (2.9% × 16.9%) = (2.9% × 0.831 / 3) + (2.9% × 0.169) = 0.803% + 0.490% = 1.29%.

Soil degradation: $43.6–941 billion, averaging 0.679% of global GDP in losses per year. Estimates include:

- UNEP 2011a [LADA project – Land Degradation Assessment in Drylands], 1, 9 ($40 billion from land degradation, without considering hidden costs of increased fertilizer use, loss of biodiversity and loss of unique landscapes; presumably in 2010$, adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)')
- Pimentel et al. 1995, 1121, and UNCCD 2011, 3 ($400 billion from soil loss, presumably in 1994$; adjusted to 2012$ using WB 2013, world, 'Inflation, GDP deflator (annual %)').

Mean and percentages (0.0601–1.30%): review's calculation using WB 2013, World: 'GDP (current US$)', 2012.

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