

Resources and Environment

A new challenge for actuaries

Over the years, climate change has become a familiar expression, in part due to the publicity given to the work and publications of the Intergovernmental Panel on Climate Change, better known by the acronym IPCC. Most people have heard of the 2 degrees Celsius threshold for the increase in the world average temperature. According to IPCC scientists, an increase beyond 2 degrees Celsius would be dangerous to our way of life and would impact economic growth. The chart (below right) shows the wider context of four projections.

- 1 **Business as Usual**, known as the BAU curve, summarises the expectations if nothing is done about Green House Gas (GHG) emissions.
- 2 **Confirmed Proposals** represents the expectations if commitments made by nations around the world by Treaty or at International meetings are executed; it is well known that most countries are not in compliance.
- 3 **Potential proposals** are more ambitious feasible proposals that are still being debated.
- 4 **Low Emissions Path** is an ideal set of commitments that would keep the temperature change below 2 degrees, but appears, so far, optimistic.

The IPCC was created in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme

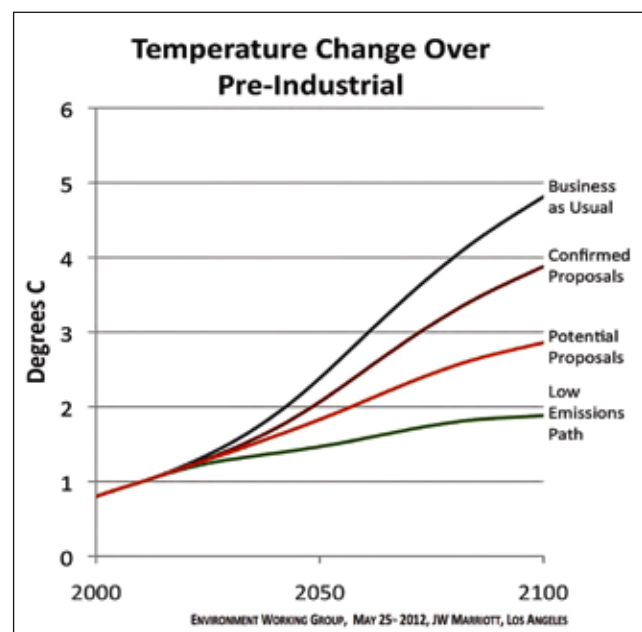
(UNEP) as a means to assess global climate change. The IPCC mandate is governed by United Nations regulations.

Even though climate change is an important component that dominates media coverage, there are other factors that are equally or even more important. Limits to growth and resource depletion are two other dimensions of the environmental challenge currently faced by mankind. These days, for example, we hear a lot about the global threats to the bee population and the dire consequences of their attrition on agricultural production. The rise in the level of the ocean is driven by global warming and this is an environment issue

but drinking water is a resource. Oil or coal are resources but how fast we burn them affects the environment and the climate. *Resources* could be seen as the word that says it all since a key constraint are the limited resources of the only one planet we know that is not light years away!

The uncertainty margins in the IPCC projections and in the assessment of available resources are multiplied by the uncertainty of the mitigating initiatives that nations around the world will effectively implement. These new challenges expand opportunities for actuaries as experts in the management of risks and uncertainty in the pursuit of sustainability. Resources

constraints and the other environment factors will have a pervasive influence on future actuarial work in all domains of practice. Our role as actuaries is to help optimise decisions. We don't seek to prove or disprove the estimates made by the experts but we need to understand what they are saying. There are two recent and very complementary reports that have been published for that purpose: one on limits and resources, the other more focused on the environment and in particular on climate change.



Note: As reproduced in *C-Loads Simulator* presentation December 2009.



TWO MAJOR REPORTS

The first of the two reports, *Determining the Impact of Climate Change on Insurance Risk and the Global Community*¹, was published in November 2012 and was commissioned jointly by The Casualty Actuarial Society, Canadian Institute of Actuaries, Society of Actuaries, and the American Academy of Actuaries' Property/Casualty Extreme Events Committee to *Solterra Solutions*, a private research firm that specialises in assessing risk and developing strategies for climate change adaptation and mitigation. The authors are three Canadian scientists involved in a variety of environmental activities. One of them, Andrew Weaver, has been a Lead Author in the United Nations Intergovernmental Panel on Climate Change (IPCC).

The second report, *Resource constraints: sharing a finite world – Implications of Limits to Growth for the Actuarial Profession*², published in January 2013, is an initiative of the UK Actuarial Profession that commissioned the Global Sustainability Institute at Anglia Ruskin University to undertake further research and modelling of the possible impacts of resource constraints on actuarial advice³. It is a short report, very well structured, covering a number of questions of interest to actuaries.

The credentials of the authors and the well-documented scientific contents make these reports a highly credible source of information for all actuaries. The global actuarial community is indebted to the four North American actuarial associations and to the Institute and Faculty of Actuaries for investing time and resources in commissioning these reports that together provide adequate coverage of the main questions the actuarial profession must address.

RESOURCE CONSTRAINTS

The report on resources demonstrates the evidence for constraints across a wide range of resources and points out that "many actors in the global economy are not considering it in their decision making process". Yet actuaries need to understand and consider the implications for their advice, assumptions and models, especially for the main actuarial assumptions including discount rates, inflation and demography. The key message is worth quoting:

"Resource constraints will, at best, increase energy and commodity prices over the next century and, at worse, trigger a long-term decline in the global economy and civil unrest."

On the positive side, the report points out that many of the worst effects can be avoided if governments and economic agents anticipate the constraints and act accordingly.

The report explores eight different outcomes that are the 'optimistic' and 'pessimistic' versions of four scenarios.

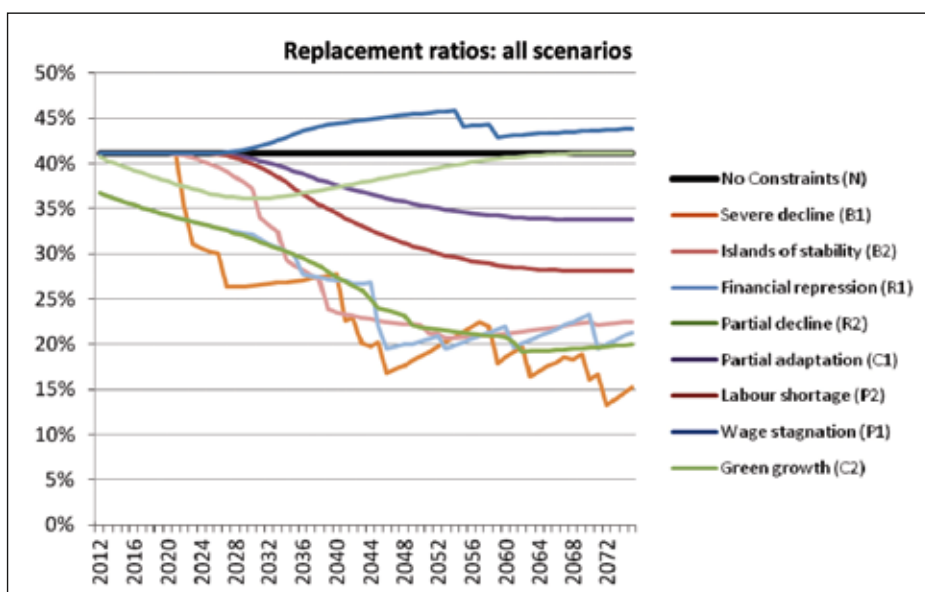
- 1 Business as usual**, that is the continuation of decision making with low sensitivity to resources limitations.
- 2 Price driven change**, where price signals reflect the long term availability of resources.
- 3 Regulation driven change**, where governments operate on a long term basis, regulating the stock rather than the flows.
- 4 Consensus driven change**, where both governments and markets operate on a long term basis for pricing and regulating the stock of resources.

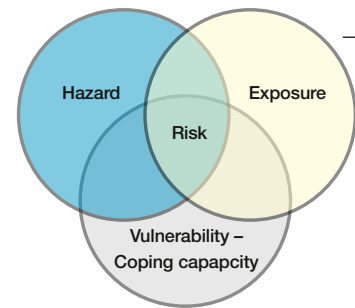
These outcomes are compared with a 'no constraints' scenario to explore a worked example of an actuarial model for a pension

scheme. It illustrates the impact on both a defined contribution (DC) scheme (comparing replacement ratios) and a defined benefit (DB) scheme (comparing the assets) from 2012 to 2072. The DB scheme shows asset reductions and even depletions before the 2072 horizon that are the counterparts of the variations in the replacement ratios for the DC schemes. The DC graph is easier to interpret and confirms the vulnerability of DC schemes as a means to generate pension income.

The report points out that, currently, actuarial models are effectively discounting to zero the probability of economic growth being limited by resource constraints. A list of 10 overall factors that may affect actuarial assumptions is provided. If resource constraints are significant, this means that current models will persistently understate the value of liabilities. A more important comment is that these scenarios do not reflect the worst-case scenario. Were the global economy to go into long term decline, the legal basis on which financial products sit could conceivably be undermined and the sponsor employer may no longer exist to pay contributions. The financial markets may also cease to exist, at least in their current form, and hence the projection would become meaningless.

The authors of this report also looked back to 1972 and the Club of Rome report *Limits to growth* which attracted lots of controversy and rejection of its scenarios. Their assessment is that present day data agrees 'worryingly well' with the 1972





projections. The GDP is the usual measure of growth, but it has many shortcomings. To remedy or mitigate flaws in the GDP, the report refers to alternative indexes of well-being, such as the *OECD Better Life Index*⁴ and the first UK Annual Report on *Measuring National Well Being* published on 20 November 2012⁵ which has 10 domains: individual well-being, our relationships, health, what we do, where we live, personal finance, education and skills, the economy, governance and the natural environment. The chapter on Growth and Debt points out that modern economies contain a large amount of debt, so they need to grow to pay back the debt, creating an overreliance on growth that puts them on a collision course with resources constraints. A distinction is made about debt taken on due to an immediate crisis, such as war, and not as an ongoing way to provide additional public finance. However, they note that debt has increasingly been used to fund 'normal' government spending.

The current crisis has re-opened the debate on limits to growth, which can be grouped under four broad themes:

- growth is the solution thanks to technological innovation;
- green growth relying on indicators more aligned with resources constraints and climate change;
- end of growth, with restructuring to accommodate a low growth future; and
- beyond the limits: where we procrastinated too long, now we need to manage a decline.

The report includes a list of questions to help frame future work for the Actuarial Profession under three headings.

- ✓ The role of the Actuary.
- ✓ Actuarial methodology.
- ✓ The impact of resources constraints.

The four-page summary should become mandatory reading for actuarial students and feature in the CPD programs for practising actuaries. The report itself is only 26 pages long.

IMPACT OF CLIMATE CHANGE

The first part of this longer report, 158 pages, is a review of the latest developments in climate science and the role of the IPCC. It is educational in its approach and easy to read. How climate change will affect society

is a complex question. In addition, climate change—given its potential for systemic impact—can dramatically alter the risk management landscape. Actuaries that are too busy should read at least the three pages Executive Summary; it should also become mandatory reading for actuarial students and feature in the CPD programs for practicing actuaries.

The report commissioned by four North American actuarial associations naturally targets an American audience where, until recently, denial of the anthropogenic component of climate change was not rare. Thus, the authors were careful in dealing with scientific uncertainty that has been misused in the past to stall action, for example, about smoking, chlorofluorocarbons and ozone depletion. The authors explicitly quote the precautionary principle that some existing level of uncertainty is not a reason for inaction, as expressed in article 3.3 of the UN Framework Convention on Climate Change (UNFCCC) to which the US and 194 other nations are parties. The report argues that the use of insurance instruments as means of pecuniary protection is highly resonant with this principle.

After reading less than half of the first four chapters, I was persuaded that even hardcore deniers would have been converted already. Scientific data continues to accumulate for two more chapters but it becomes clear later that the additional material provides the scientific background for the development of actuarial Climate Indices, namely the Actuaries Climate Change Index (ACCI) and the Actuaries Climate Risk Index (ACRI).

The last three chapters are dedicated to the development of climate indices and hence to Impacts and Risk assessment. The report proposes a definition of risk that "may be estimated quantitatively as the product of separate functions of hazard, exposure of assets and vulnerability."

The formula combines the three functions and reads:

$$\text{Risk} = C.f(H).g(E).s(V).$$

where C is a proportionality constant. The variables H, E and V could reflect time and location. The formula is "modular in the sense that climate hazards, exposure and vulnerability are represented as separate factors". In this form the Actuarial Index can be directly substituted for f(H). Insurance companies could use this approach to derive

adjustments to their risk assessment process reflecting a consolidated expected impact of climate change. As the conclusions point out "this would represent a significant advance over existing approaches, which cover only a limited array of climate hazards, and are not standardised to reflect the key role of climate variability." The report concludes as follows:

"While only a rough framework has been sketched here, it seems clear that further investigation in any of these areas would reap significant rewards in terms of estimating the threat of hazards arising from climate change on life, property, and natural capital."

I'd like to respond to that implicit appeal by suggesting two areas for further investigations:

- Could the ACRI support the underwriting of climate bonds that would play, for climate, the role of longevity bonds in hedging mortality risks?
- Developing the stochastic dimension for the climate indices.

Actuaries that wish to follow-up on future developments may take advantage of this at the *International Congress of Actuaries* being held in Washington DC from 30 March 2014. Several presentations on the program will review resources and environment issues. **A**

Yves Guérard, FSA, FCI, Hon FIA, PhD was the Secretary General of the International Actuarial Association from 1997 to 2010 and responsible for the creation of the IAA Environment Working Group that he chaired until May 2012.

¹ The full text is available at <http://www.soa.org/Research/Research-Projects/Risk-Management/research-2012-climate-change-reports.aspx>

² Written by Dr Aled Jones, Irma Allen, Nick Silver, Catherine Cameron, Candice Howarth & Ben Caldecott. <http://tiny.cc/aohqrw>.

³ Supporting evidence is available in Jones, Allen, Silver, Cameron, Howarth & Caldecott, 2013, Resource Constraints: The Evidence and scenarios for the future, The Institute and Faculty of Actuaries

⁴ <http://www.oecdbetterlifeindex.org>

⁵ http://www.ons.gov.uk/ons/dcp171766_287415.pdf