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VOLUME 15 ISSUE 2

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OBSERVING MOTHER NATURE

The challenges of climate change

Moving past the debate

Double threat



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The Actuary is published bimonthly (February/March, April/May, June/July, August/September, October/November, December/January) by the Society of Actuaries, 475 N. Martingale Rd., Suite 600, Schaumburg, IL 60173-2226. Periodicals postage paid at Schaumburg, IL, and additional mailing offices. USPS #022-627.

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The Actuary is free to members of the Society of Actuaries. Nonmember subscriptions: students \$22; North American \$43; Int'l \$64.50. Please send subscription requests to: Society of Actuaries, P.O. Box 95600, Chicago, IL 60694-5600.

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Connecting With the Strategic Plan

The SOA keeps actuaries at the forefront of evolving methods for solving complex business problems.

Have you ever wondered how or why the Society of Actuaries (SOA) makes decisions about curriculum changes or industry disruptors like InsurTech? The answer is our Strategic Plan. The SOA Board of Directors approved the current plan (2017–2021), and it is our organization’s guide to help make decisions. As members, you also can use it to provide insight into future projects and investments the SOA makes.

We don’t expect members to memorize the Strategic Plan areas, but we encourage everyone to be familiar with it. Visit SOA.org/strategicplan to view details on the mission, vision and current initiatives the SOA Board is working on right now.

Now, the question is: How do we bring it to life?

The answer is through you as an actuary. The Strategic Plan states, “SOA’s credentials are prestigious, relevant and globally recognized.” One way members can demonstrate this is to help spread the word about the actuarial profession. Volunteer to speak at a local school career fair or math classroom. The SOA has presentations and handouts to assist you with these

activities. Learn more about the updated ASA, FSA and CERA curriculum pathways (pathways.SOA.org) and share with employers and colleagues.

With the changes in the SOA curriculum for associates and fellows, there is an added emphasis on predictive analytics for future actuaries. But what about for members?

The Strategic Plan says, “The SOA keeps actuaries at the forefront of evolving methods for solving complex business problems.” Predictive analytics is an important example of such evolving methods. In addition to continuing professional development sessions and webcasts, the SOA offers the 2018 Predictive Analytics Symposium and the Predictive Analytics Certificate Program, offered twice this year. Members may also consider participating in the SOA-sponsored Kaggle Involvement Program, which is a competition to showcase the predictive analytics work of actuaries. More details on the Kaggle program will be available later this year.

The SOA Strategic Plan looks to “continuously identify, analyze and prioritize responses to environmental changes in a timely manner.” Members can assist the SOA with this, too. See a trend forming that could impact the SOA or the profession? Let the SOA know by completing the Environmental Scanning Observation form, which will go straight to our Issues Advisory Council (IAC). Taking a few moments to send your observations can help the SOA identify new challenges and opportunities.



MIKE LOMBARDI, FSA, CERA, FCIA, MAAA, is president of the Society of Actuaries. He can be reached at mlombardi@soa.org. Find him on LinkedIn at bit.ly/MLombardiSOA.

Do you have individuals who provide support for your actuarial team? If so, consider sharing information about the certified actuarial analyst (CAA) qualification with your employer and colleagues. As part of our strategic plan “to deliver actuarial education that anticipates stakeholders’ changing expectations,” the SOA formed a joint venture, CAA Global, with the Institute and Faculty of Actuaries (IFoA) to offer the CAA qualification. The SOA also formed a subsidiary, SOA Center for Certified Actuarial Analysts, to support CAA affiliates. Now actuarial support staff can obtain a qualification with the confidence of a rigorous exam process approved by the SOA.

As part of the strategy to “construct research programs on key industry and societal issues,” the SOA created and completed a new initiative to pursue research on five key Strategic Research Programs: Aging and Retirement, Actuarial Innovation and Technology, Mortality and Longevity, Health Care Cost Trends, and Catastrophe and Climate. For more details on the Strategic Research Program Initiative, read the research column on page 74 of this issue. The SOA Strategic Research Programs ([SOA.org/strategic-research/default](https://soa.org/strategic-research/default)) are an important part of our organization and an opportunity for you to participate either as a member of a research planning committee, spreading the word about research proposal requests and, easiest of all, sharing articles and news coverage about SOA research findings and their impact on societal issues. We post those articles in your member email newsletter, *SOA News Weekly*, so they are easy to read and share.

RELATED LINKS

Predictive Analytics Symposium

bit.ly/2018PASymposium

Predictive Analytics Certificate Program

SOA.org/pacertificate

Kaggle Involvement Program

bit.ly/KaggleInvolvement

Environmental Scanning Observation Form

bit.ly/EnvironmentObs

CAA Global

CAA-Global.org

SOA Center for Certified Actuarial Analysts

SOAcenter.org

In closing, I have shared with you the ways you can participate in the SOA’s strategy. Please consider sharing your thoughts on the plan and emerging issues with the SOA and with others. Share how you think the SOA is doing to bring its mission and vision to life for you as an actuary. I welcome your thoughts and perspectives, and I hope to work with you to realize a future of relevance and recognition throughout the world. ■

If you are planning to volunteer to speak at a local school career fair or math classroom, contact candidateconnect@soa.org for presentations and handouts to help guide your communication.

REDESIGN

The Actuary has a new look and feel. As you flip through the pages of this issue, you’ll notice new department and feature headers, new sidebar treatments and a refreshed layout style overall. You’ll also find two new departments—one on diversity and inclusion (page 66) and one about the rich history and bright future of the SOA and the actuarial profession (page 78). Enjoy!



Let's Chill Out!

BY DOROTHY L. ANDREWS

Attitudes toward climate change influence government spending, and the level of spending can be correlated to measurable effects that reduce the harmful impact of climate change on human life and our planet.

RELATED LINKS

History of Earth's Surface Temperature 1880–2016

bit.ly/Surface-Temp-History

Reported Federal Climate Change Funding by Category

bit.ly/ClimateChangeFunding

ON SEPT. 9, 2016, NOTED ECONOMIST AND NOBEL PRIZE WINNER PAUL KRUGMAN WROTE AN ARTICLE in *The New York Times* discussing the “Big Liar” technique, a modification of the “Big Lie” technique. The Big Lie technique is a propaganda tool founded in the belief that if a big lie is repeated often enough, people will eventually believe it. This is because, as Krugman reports, it is hard for people to reconcile a false statement told on such a grand scale to be false.

The Big Liar technique is similarly defined but based on a medium-sized falsehood. Our current political environment has many questioning the validity of climate change because of the many claims in the

media that it does not exist, despite mountains of scientific evidence that our earth has grown warmer since the late 1880s. The rising temperature of our planet is studied and documented by many well-respected national and international organizations. And yet, despite the hard science, there are many among us who have been swayed to believe climate change is “fake news.”

Attitudes toward climate change influence government spending, and the level of spending can be correlated to measurable effects that reduce the harmful impact of climate change on human life and our planet. From 1993 to 2014, fiscal budgetary expenditures in the three categories of international assistance, technology and science increased

from \$2.4 billion to \$11.6 billion, as reported by the U.S. Government Accountability Office (GAO).¹

The line items in the federal budget allocated to climate change include:

- » Assistance with climate change initiatives in developing countries.
- » Technology to assist with the reduction of carbon dioxide and other greenhouse emissions.
- » Science programs to study and promote education on climate change.

The comparable numbers for 2015, 2016 and 2017 are \$9.9 billion, \$11.4 billion and \$12.8 billion, respectively, as reported by the Institute for Policy Studies in an October 2016 report titled, “Combat vs. Climate: The Military and Climate Security Budgets Compared.” These numbers exclude spending on natural resource adaptation, energy tax provisions to reduce greenhouse gases, and energy payments in lieu of tax provisions, which amounts to many more billions of dollars. Even if included, climate change budgetary allocations are a tiny fraction of government spending on the military. The 2018 U.S. Fiscal Budget, “A New Foundation for American Greatness,” proposes to cut climate change budgetary expenditures by a whopping 31 percent. The Clean Power

Plan, which mandates states to transition from coal-fired power plants to reduce carbon emissions by 32 percent, is defunded in this budget. This program represents a major weapon in the battle to keep the temperature of our earth to within 2 degrees Celsius of pre-industrial temperature levels as urged by scientists around the world.

In this issue, *The Actuary* is honored to welcome two scientists from NOAA to reaffirm the science on climate change. Stephanie C. Herring, Ph.D., is a scientist and senior adviser with NOAA’s National Centers for Environmental Information, Center for Weather and Climate. Her areas of focus are extreme events and climate services, and she is a leading expert in understanding and explaining the physical drivers of climate extremes and their temporal changes in risk exposure. Jesse E. Bell, Ph.D., is a scientist and research scholar for the NOAA-funded Cooperative Institute for Climate and Satellites in North Carolina. His research explores the relationships of climate change and climate variability on natural and human processes. He studies the link between climate extremes and the terrestrial water cycle, which is responsible for the maintenance of our ecosystems. Climate change is threatening to destroy our terrestrial

water cycle, as is evidenced by the disappearance of lakes, rivers and other bodies of water, and the erosion of coastlines in many parts of our Earth. Identifying the physical drivers of climate change requires advanced modeling techniques on large amounts of weather data and experimental design research, among other techniques.

In her guest editorial, Caterina Lindman discusses how we all can begin eating to stop climate change by switching to a whole foods, plant-based diet. Her article changed my life. I am now transitioning to a whole foods, plant-based permanent way of eating. I prefer not to call it a “diet,” a word that connotes for many a temporary way of eating. Sam Gutterman talks of the harmful impacts of climate change on human mortality of the most at-risk populations—the poor, the frail, the young and elderly, minority populations, those closest to the equator and those with inferior access to health care. He identifies how changes in temperature and precipitation are linked to diseases that drastically reduce human longevity. Barbara Zvan-Watson discusses the impact of climate change to the financial management of pension funds, while Yves Guerard and Kenneth Donaldson discuss the representation of the actuarial profession globally on the battlefield

to fight climate change. As actuaries, we are globally united in this fight and well positioned to measure and communicate the effects of climate change on the human experience.

Welcome to the climate change issue of *The Actuary*. I hope our readers will enjoy this informed discussion of the impact of climate change on our health and the health of our planet, and be called to action. Collectively, starting today, we can improve the health of our planet by changing how we live on it.

Keep calm, get involved and eat plant-based, whole foods—so our planet can chill out! ■



ABOUT THE WRITER

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Reference

¹ U.S. Government Accountability Office. 2015. “Climate Change Funding and Management.” February. https://www.gao.gov/key_issues/climate_change_funding_management/issue_summary#t=0.

Programa Internacional en Ciencias Actuariales

The Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS) sponsored the *Programa Internacional en Ciencias Actuariales* May 8–11 in Bogotá, Colombia.

INS-Fasecolda organized this four-day event for actuaries, which provided participants with basic and advanced knowledge in quantitative tools used by international professionals in actuarial science. Participants also were able to analyze the practices in the management of life insurance and general applications, including billing, calculation of technical reserves and management of assets and capital. Both the CAS and the SOA provided expert speakers at the event, and networking events included a gala dinner on May 8.

China Annual Symposium

The China Annual Symposium will take place May 28–29 in Beijing, China. This event will provide learning and networking opportunities to attendees.

Susan Blanck, FSA, MAAA, will welcome attendees to this SOA signature event. Blanck is a former executive vice president at Aflac, Japan, and she is an SOA Board member and International Committee chair.

This year's China Annual Symposium will include sessions on macroeconomic and financial environments, insurance regulation, financial management, application of new technologies in actuarial practice, investment, critical illness product and strategies of insurance companies.

Making a Difference—Shaping a New Future

The SOA will hold the Asia-Pacific Annual Symposium May 24–25 in Seoul, South Korea, under the banner “Making a Difference—Shaping a New Future.”



Seoul, South Korea

The event relies on help from the Institute of Actuaries of Korea (IAK) and the Korea Insurance Development Institute (KIDI).

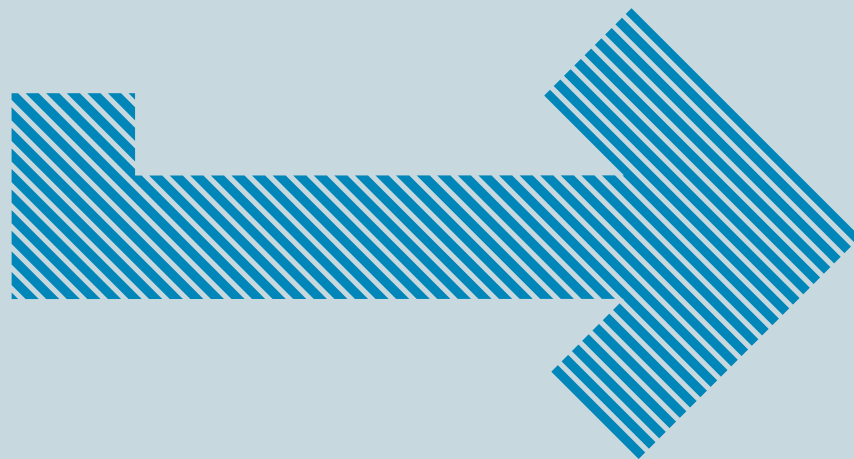
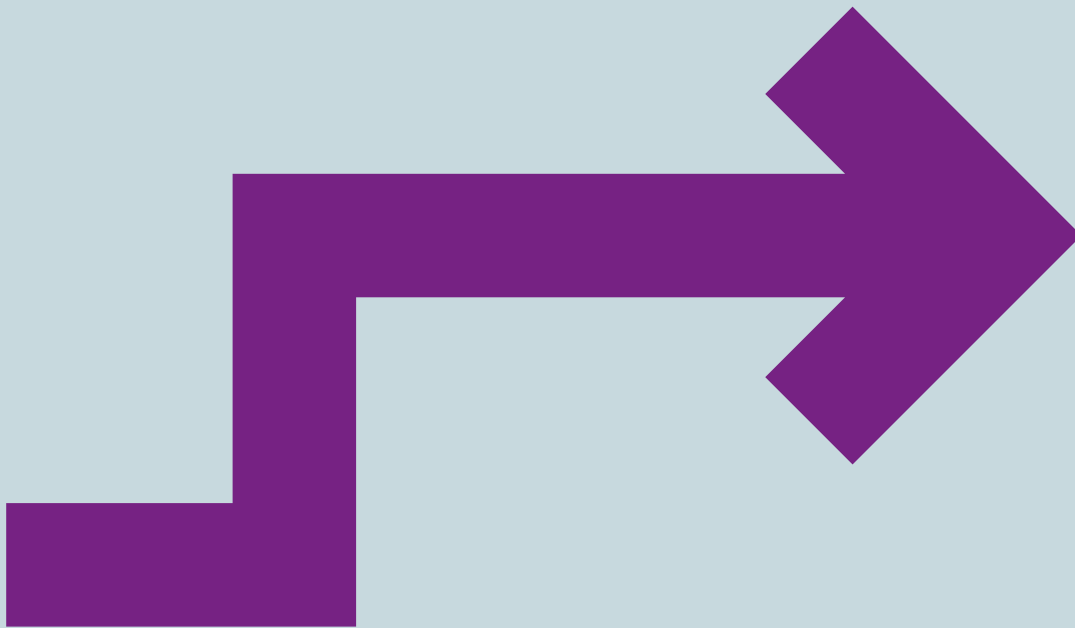
This year's symposium will kick off with welcome remarks by the chair of the SOA Greater Asia Committee, J. Peter Duran, FSA, CERA, MAAA, Ph.D.; SOA Board member and International Committee chair Susan Blanck, FSA, MAAA; the IAK; and Park Jongsoo from the Financial Supervisory Service (FSS) of the Republic of Korea.

Keynote speaker Jun Seop Lee, FIAK, executive vice president at KIDI, will provide an overview of current trends in InsurTech in the Korean insurance industry and discuss how the role of insurance companies may change in the future. Blanck follows Lee with an additional keynote speech. Her session, titled “Translating Actuarial Insights Into Action,” will provide attendees with tools and techniques to communicate actuarial information clearly and confidently.

Attendees can network with industry leaders, SOA staff and expert speakers from the FSS, IAK and KIDI at the network reception that closes the first day of the symposium. SOA Senior Director of Asia and Latin America, Ann Henstrand, and R. Dale Hall, FSA, CERA, MAAA, managing director of Research for the SOA, will attend the event.

“Translating Actuarial Insights Into Action” will provide attendees with tools and techniques to communicate actuarial information clearly and confidently.

Continued on page 12



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Continued from page 10

The Long-term Care Section update

The Long-term Care (LTC) Section is, in many ways, the most diverse section of the Society of Actuaries (SOA). Our membership hails from the intersection of brokerages and agencies, actuarial firms and valuation units, claims and operations divisions, and legal and regulatory departments. The medley of professional backgrounds makes for healthy and interesting conversation. And we're happy to welcome more into the fold.

Our section members have responded to the stagnating traditional LTC insurance market by shoring up our management and analyses. We have pivoted to understand the new opportunities in the financing and delivery of LTC services and supports (LTSS). Subtending these transitions, the LTC Section has maintained its focus to provide education and thought leadership to support our professionals in their daily work.

The LTC Section promotes the education of its membership through a multitude of media, including webcasts, podcasts, webinars aimed at regulator education and the LTC newsletter. The Section Council ensures that we have relevant LTC content at all major industry conferences including the ILTCI Conference; the SOA Health Meeting; the Life & Annuity Symposium; the Supplemental Health, DI and LTC Conference (SHDILTC); the Valuation Actuary Symposium; and the SOA Annual Meeting & Exhibit.

The LTC Think Tank¹ provides thought leadership, working to understand the future opportunities for our industry to serve those who will need LTSS. The LTC Section is collaborating with the Health Section and the Predictive Analytics and Futurism Section to produce some exciting new content. Watch for the fruits of these labors in newsletter articles and industry conference presentations in 2018, beginning with the SOA Annual Meeting & Exhibit. There are a host of InsurTech companies that stand to make a sizable impact in the LTC space, and our section is eager to better understand this opportunity. Finally, predictive analytics is playing an expanding role in the LTC actuary's world. There will be more content at upcoming SOA events and the ILTCI conference featuring emerging work in the predictive analytics space.

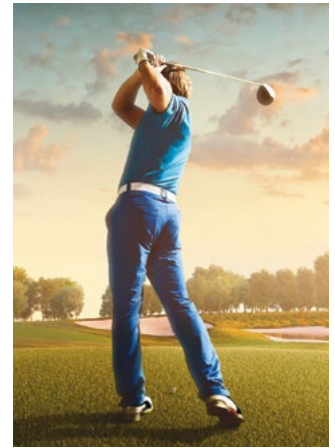
The LTC Section has an active membership committed to providing the products, analysis and solutions supporting those who need long-term supports and services. With a collective century of LTC experience under their belts, our Section Council members are dedicated to providing conscientious leadership and guidance for our activities. Please stop by and say "hi" at one of our section breakfasts during the SOA Health Meeting and SOA Annual Meeting & Exhibit, or visit us at SOA.org/ltc.

Reference

¹"Long-term Care Think Tank." Society of Actuaries. <https://www.soa.org/sections/long-term-care/lcthinktank/>.

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Striking a healthy work-life balance

CFO.com reports in its article, "10 Habits of Highly Effective CFOs," that striking a healthy work-life balance is of paramount importance. The article offers a good formula for success: family, friends, physical exercise, reading, hobbies and community service.

bit.ly/2DSE5GS

Is artificial intelligence a threat to jobs?

According to a recent *The New York Times* article, the vast majority of Americans expect artificial intelligence (AI) to lead to job losses in the near future. However, they do embrace AI in attitude and practice.

nyti.ms/2FsQ1N7

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Eat Responsibly

How an actuary learned that plant-based, whole foods are better for the climate and your health

BY CATERINA LINDMAN

Jane Goodall—conservationist, anthropologist and primate expert—is concerned, as I am, for our planet. Referring to the buildup of greenhouse gas emissions in our atmosphere, the loss of biodiversity, rainforest destruction and conflicts over resources, she emphasizes the need for personal action: “Only if we understand can we care. Only if we care will we help. Only if we help shall all be saved.”¹



Switching to more plant-based diets has been singled out as an important strategy to mitigate climate change because it would use less land and energy for growing food.

I have been studying, writing and speaking about climate change for more than a decade. In this editorial, I will share some of the insights I have gleaned from this work in an attempt to illustrate the urgency and interconnectedness of the climate change crisis with other global issues. Then, by detailing my own experiences—specifically with regard to my attempts to align my dietary choices with my social and political values—I hope to do the following:

- ① | Make the case against the standard American diet (SAD), which is common in the United States and Canada, as well as in other countries.
- ② | Highlight the need for individual responsibility to take action against the global climate crisis.

Ultimately, my hope is to increase the levels of understanding, caring and helping that can bring our planet back to a more stable climate, with increased well-being for humans and non-humans alike.

Personal Response to Climate Change

Like many people, I first responded to climate change by looking at how our household used energy and then by implementing strategies to reduce the energy we used. Many of those changes to reduce our energy use—such as turning off lights when leaving a room or hallway, turning down the heat and putting on an extra layer of clothing, buying only those things that we *really* needed, favoring used items over new, and biking and walking for short trips—were remarkably easy to adopt in our home.

I also had the opportunity to join the International Actuarial Association’s Task Force, which was considering whether it would be useful to develop an Actuaries Climate Index (ACI). The goals of the Index would be twofold:

- ① | To educate and inform the public and policymakers about climate change.

- ② | To highlight actuarial skills in nontraditional areas.

The ACI was launched in November 2016, through the collaboration of the American Academy of Actuaries (the Academy), the Canadian Institute of Actuaries (CIA), the Casualty Actuarial Society (CAS) and the Society of Actuaries (SOA).

As our team worked with the climate scientists at Solterra Solutions, we learned more about climate change—and I became even more concerned. It was clear to me that, while the ACI would raise awareness and provide insights into climate change, it would not impact public policy, which is what was really needed. Similarly, our household’s efforts to reduce our carbon footprint were not being replicated in the numbers needed to tackle the scope of the problem, and a more societal response was needed.

As I watched the United Nations climate negotiations, three things become clear to me:

- ① | While many countries have come to the table to negotiate an agreement, the amount of ambition put forth by all the nations is not enough to prevent catastrophic warming.
- ② | Time is running out for our planet.
- ③ | This is not the time to give up. Indeed, we must redouble our efforts to reduce greenhouse gas emissions used by our own households, and to help build the political will for government action.

During the Christmas holidays of 2014, I watched the documentaries *Forks Over Knives* and *Cowspiracy*. The premise of *Forks Over Knives* is that many chronic diseases in our society are caused by the SAD, and can be prevented and even reversed by eating whole, vegan foods. The title *Forks Over Knives* is based on the use of forks (i.e., eating choices) rather than knives (scalpels used in heart surgery). *Cowspiracy* is about how animal agriculture is destructive in its impacts, and is a large user of



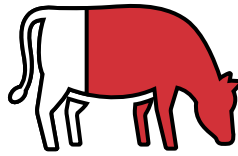
Our household’s efforts to reduce our carbon footprint were not being replicated in the numbers needed to tackle the scope of the problem, and a more societal response was needed.

land, energy and resources. The *conspiracy* part of the title refers to the fact that environmental organizations had been largely silent in highlighting the impacts of animal agriculture to their members. Feeding grain to animals in large quantities while people starve is not right. There are more than 800 million malnourished people,² and nearly one-third of the population is overweight or obese.³ Cattle ranching enterprises now occupy nearly 75 percent of the deforested areas of Amazonia.⁴ Many people in developed nations have chronic diseases due to poor dietary habits that are now considered the norm.

Assessing My Values

I began to consider how eating animal products was not in line with my values, as I want everyone on this planet to get enough food to eat, and I don't support the destruction of the rain forest and the creation of ocean dead zones because of our voracious appetites for meat. These documentaries made a lot of sense to me and inspired me to learn more. Switching to more plant-based diets has been singled out as an important strategy⁵ to mitigate climate change because it would use less land and energy for growing food. Using less land for growing food would allow that land to revert to natural vegetation, which would store carbon, thereby mitigating climate change and preserving biodiversity. Using less energy for growing food also mitigates climate change by reducing greenhouse gas emissions. I was also fascinated by the body's ability to reverse chronic illnesses through good nutrition, and it seemed to me like a good opportunity to help people regain their health while making our food system both more equitable and efficient, with a much lower carbon footprint.

When we started experimenting with whole, plant-based foods, I was neither obese nor diabetic, but I did have borderline high cholesterol levels. My husband had high cholesterol and was put on a



Cattle ranching enterprises now occupy nearly **75 percent** of the deforested areas of Amazonia.

low-dose medication. He was told to watch his diet and not eat too much meat. I asked my husband to watch *Forks Over Knives* with me, which he did. I started cooking more whole-food, plant-based meals, and asked my family if they would be willing to adopt a whole-food vegan diet for Lent. My daughter said she would eat the vegan meals I cooked, but she reserved the right to eat cheese at other meals. My husband was also in agreement, but he reserved the right to go out and get fish and chips occasionally.

The experiment was successful. My husband started eating oatmeal regularly, and he thinks that doing so really helped with his cholesterol levels and with his weight loss. He feels more energetic and better when he eats whole, vegan foods. I wasn't looking to lose weight, but I did and now I weigh what I weighed when I was in my 20s. My cholesterol levels are no longer in the "borderline high" zone, and the extra energy I feel is much appreciated! I have a heightened awareness of chronic diseases in my friends and family and, when appropriate, I share what has worked for me. I find that when I eat a standard American meal, I can feel the difference. It is more difficult to digest and, therefore, leaves me with less energy.

What Is the Standard American Diet?

The SAD began after WWII,⁶ as people in the United States started eating more meat and fewer fruits and vegetables. The SAD is not optimal, despite the fact that many developing nations are adopting it as their wealth increases. It includes a great deal of dairy products, eggs, fish and meat (about 200 pounds of meat consumption per person per year).

I have learned that there are many issues with animal agriculture, including the risk of food poisoning, high cholesterol, IGF-1 (a carcinogen found in meat), bioaccumulation of toxic pollutants, saturated and trans-fats, and the amount of grains fed to livestock while people in need are malnourished.

The production of beef uses approximately 10 times the resources of alternate livestock categories, such as poultry and pork. Alternate livestock categories use about the same amount of water, and from two to six times the resources of plant-based foods.⁷ The intensity of resource use for animal agriculture is an important factor in climate change both due to the direct emissions from the production and use of energy and chemical fertilizers, and from the conversion of land from forests (which are a carbon sink) to pasture or cropland.

A plant-based, whole foods diet is one where health-promoting foods are eaten, and foods that have been proven to lead to disease are avoided. One analogy that I like is that food is a package deal: Animal protein comes in a package with saturated fat, cholesterol and no fiber, while plant protein comes in a package with no cholesterol, very little fat, fiber and phytonutrients (chemical compounds found in plants that are beneficial to human health).

If you are considering the change to a plant-based, whole foods diet, here is what I have learned:

- » Cholesterol and saturated fats, which are predominantly found in animal products, have a negative impact on health.
- » In contrast, fiber and phytonutrients, which are solely found in plant foods, are good for health. About 97 percent of the U.S. population does not get enough fiber. It's clear that any replacement of animal products with unrefined plant products will increase the amount of fiber a person eats—improving health by aiding digestion, relieving constipation and helping to unclog blood vessels.⁸
- » The consumption of fish and animal products is associated with higher levels of inflammation, which can be a source of debilitation. Eating fish, whether farmed or wild-caught, is also problematic due to toxins such as methylmercury.⁹



About 97 percent of the U.S. population does not get enough fiber.

- » There is too much sugar in the SAD. Sugar is a leading cause of obesity and a factor in the development of diabetes, which is reaching epidemic proportions. Calories in sugar displace nutrition that could be received through more healthful dietary choices. Artificial sweeteners make a poor substitute because they have been shown¹⁰ to not help people lose weight, so other strategies are likely needed.
- » Too much salt, which is typical in the SAD and contributes to high blood pressure, is a major risk factor for heart disease.

A whole foods, plant-based diet goes a bit further than a vegan diet (which also excludes animal products) because whole plant foods are chosen over processed plant foods. To illustrate, unpeeled baked or boiled potatoes are chosen over french fries, beets are eaten as a vegetable rather than in the form of beet sugar; and whole-grain breads, baked without preservatives, are chosen over mass-produced white bread. Fat is obtained from nuts and seeds—that is, whole foods rather than from oil, which is a refined product. Sweetness comes from eating fruit, rather than from processed sugar, high-fructose corn syrup or artificial sweeteners. Herbs and spices are chosen over adding lots of salt. The diet is rich in fiber and phytonutrients, which are important for health. It should be noted that a whole foods, plant-based diet is a radical shift from the SAD. But with this radical shift in eating comes a radical shift in positive health outcomes and resource use.

Almost 35 years ago, Dr. Denis Burkitt, a surgeon who worked in Africa, wrote:¹¹

Many of the major and commonest diseases in modern Western cultures are universally rare in third-world communities, were uncommon even in the United States until after World War I, yet have comparable prevalence today in both black and white Americans. This finding compels the conclusion that these diseases must be due not

to our genetic inheritance but to our lifestyle. This conclusion in turn argues that they must be potentially reversible.

Since that time, more nutrition research has been conducted: “In the light of strikingly consistent observations from many epidemiological studies, there can be little doubt that the habitual consumption of diets high in fruits and vegetables helps to reduce the risk of development of degenerative diseases, including many types of cancers.”¹² On the other hand, as other nations adopt the SAD, their incidence of chronic diseases such as heart disease, obesity, diabetes and inflammatory bowel disease is increasing.

Overcoming Obstacles

Certainly, a whole foods, plant-based diet can be effective for people who want to gain more control over their health. But it is also attractive from an environmental and compassionate perspective, and it reduces the amount of money spent on health care and food.

There are, nonetheless, obstacles to shifting the population away from the SAD and towards adopting a whole foods, plant-based diet. The majority of us, here in North America, continue to find the SAD attractive. Among the forces that urge us to maintain the status quo are:

- » The role of the SAD as part of our culture
- » The power of advertising to greatly affect consumer choice
- » The profitability and convenience of refined and processed foods
- » Size and influence of large food corporations
- » The lack of training for doctors on nutrition
- » The protocols for—and payments to—doctors tend to be geared to treatment, rather than prevention, of chronic illness
- » The profitability for pharmaceutical companies selling drugs for chronic conditions

There is too much sugar in the Standard American Diet. Sugar is a leading cause of obesity and a factor in the development of diabetes, which is reaching epidemic proportions.



- » The addictive nature of processed foods (e.g., sugar, salt, fat)¹³
- » People think that making the shift will be too difficult and not taste good

These are sizable obstacles. However, there are also some forces that have compelled me to move away from the SAD toward a whole foods, plant-based diet. These forces include:

- » The dissemination of knowledge¹⁴ and people's stories through the internet
- » The efficacy of a whole foods, plant-based diet in weight loss, feeling more energetic, and in the lowering of risk factors for chronic disease¹⁵
- » The ability of human taste buds to adapt to a change in diet, finding the new diet palatable¹⁶
- » The desire to mitigate the suffering from chronic disease in ourselves and in those we care about
- » Concern about food toxins—people can significantly reduce their exposure to toxins by eating plants rather than animals, as toxins bioaccumulate in animals
- » The intention of governments to address climate change, which will mean less use of fossil fuels and fossil-fuel-derived chemical fertilizers, which will increase the price of animal products much more than the price of plant foods
- » Life and health insurance companies using a strategy of promoting wellness to reduce claims and increase customer engagement
- » Governments looking at wellness programs and dietary guidelines as a way to prevent disease and potentially mitigate climate change (e.g., China's new dietary guidelines limit meat consumption to between 31 and 59 pounds per person per year,¹⁷ while Canada's draft Food Guide recommends "regular intake of vegetables, fruit, whole grains and protein-rich foods, especially plant-based sources of protein"¹⁸)
- » Governments putting a tax on sugar-sweetened beverages (France and Mexico have recently introduced these taxes and have seen a decline in sales)¹⁹
- » The routine measurement of cholesterol levels and the use of diet as a primary management tool for high-cholesterol levels

Populations that rely on subsistence agriculture are particularly vulnerable to climate change, and this can lead to famine, social unrest and migration. The food system is a major user of land and energy resources. The mitigation

ACTUARIES FOR SUSTAINABLE HEALTH CARE

Actuaries for Sustainable Health Care is a new organization of actuaries dedicated to achieving the long-term sustainability of health care financing systems, through the use of whole-food, plant-based nutrition. It has the following founding principles:

- 1 | Whole-food, plant-based nutrition is more effective than any other drug, surgical procedure or dietary intervention at reversing a wide range of chronic conditions such as heart disease, hypertension, type 2 diabetes, obesity, rheumatoid arthritis and inflammatory bowel conditions.
- 2 | Any health care financing system or reform proposals for these systems that incentivize prescription drugs, medical procedures and tests over interventions that address the underlying cause of chronic conditions are unsustainable.
- 3 | Given that whole-food, plant-based nutrition has no negative side effects and requires no additional cost (everyone needs to eat), all health care financing systems should inform their members of how this approach can reverse and prevent chronic disease.
- 4 | Actuaries, given their training and experience with a variety of financial security systems, are ideally suited to develop sustainable solutions for health care financing systems that incentivize health care providers to discuss whole-food, plant-based nutrition with patients.

Please consider learning more about this organization and whole-food, plant-based nutrition at actuariesforsustainablehealthcare.org.





of climate change requires much less use of fossil fuel energy, allowing land to be used to store carbon through forests and reforestation.

Conclusion

I am now convinced that a shift to a whole foods, plant-based diet would help immensely to mitigate climate change, improve human health²⁰ and enhance food security. The transition to healthier eating patterns will have a profoundly positive impact on health care costs, and is key to the long-term sustainability of health care systems.

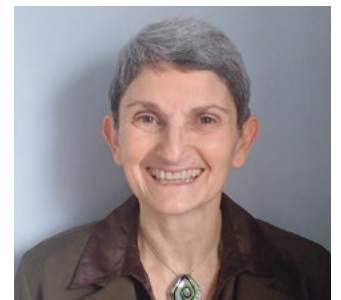
Changing one's diet is not an easy choice to make. It involves engaging with the people with whom you eat, and a commitment to eating different foods—or the same foods, prepared differently. It is a process of trial and error to find foods you enjoy, and it requires an open mind to try new foods and to establish new cooking and eating patterns. The journey of changing to a whole foods, plant-based diet has many rewards. I invite you to consider how you might want to change some of your eating patterns to help save the planet and improve your health. Your understanding, caring and help is needed! ■

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SOA Explorer Tool

Find Actuaries Around the Globe

The SOA Explorer Tool is a global map showing locations of fellow SOA members and their employers, as well as actuarial universities and clubs.

Explorer.SOA.org



The Challenges of Climate Change

The global actuarial response to the difficulties of climate change

BY YVES GUERARD



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lobal warming is not a black swan, and actuaries around the world have been aware for many years of the importance of this phenomenon. Climate change is not limited to global warming, but combines uncertainty with risks of a variety of extreme weather events and rise in sea levels. The special expertise of actuaries in managing risks and uncertainty, combined with their understanding of future scenarios, entails a social responsibility.

The primary responsibility of actuarial associations is to ensure that actuaries are adequately informed, develop best practices and build the expertise necessary to provide advice of high quality. The basic objective is to ensure the sustainability of insurance products and social protection programs, despite pervasive impacts of climate change on actuarial methodology and assumptions. Furthermore, actuaries need to work with other professionals and share information to enable decision makers and civil society to correctly assess the policy choices that will define our collective future.

Actuaries can appreciate the gap that the high-risk appetite nations are displaying with regard to achieving the common goal of keeping global warming below 2 degrees Celsius, in comparison to the level of risks we tolerate in other undertakings. Nations around the planet are slow to wake up to the gravity of this challenge to a secure future, and the actuarial profession shares some part of the responsibility. This calls for increasing public outreach to help promote a greater sense of urgency in taking difficult initiatives that may profoundly affect our way of life. Such initiatives are essential to increase the probability of success in reaching our common goal.

How does the global actuarial profession respond to the challenge of climate change? Although it is not exhaustive, the following summary demonstrates that the actuarial profession is taking seriously its responsibility to help humanity face the challenges that climate change poses to our society and way of life.

PRINCIPLE OF SUBSIDIARITY

The harmonization and coordination of the deployment of resources by the International Actuarial Association (IAA) and its member associations rest on what is known as the Principle of Subsidiarity enshrined in the current IAA statutes adopted in 1998. It reads:

Article 8 Cooperation—The IAA will restrict its activities to strategies and programs, which require international coordination or direction, or can be handled more efficiently across national and regional boundaries. It will not become involved with actions at the level of the member associations or regional groups of actuarial associations, except at the express invitation of such an association or group.

The IAA will therefore take any measures necessary to avoid duplication or overlap with the activities of member associations or regional groups of actuarial associations.

Thus, the respective mandates respect the principle of subsidiarity and optimize the utilization of the limited resources of a profession with a global membership limited to approximately 65,000 individuals distributed across 110 countries.

A Three-Level Response

The actuarial profession is responding at three levels: international, regional and local. The context is that the International Actuarial Association (IAA)—which has the mandate of moving the profession forward internationally—is an association of associations and has no individual members. Thus, essentially the human resources of the global profession are the resources of its full member associations (FMAs) that certify individual actuaries at the local or national level.

The IAA

Climate-related activities at the international level are conducted mainly by the Resources and Environment Working Group (REWG) of the IAA. The creation of a working group was authorized in September 2009. By May 2011, 24 members had been recruited, and Terms of Reference were drafted and adopted on Sept. 29, 2011. Its launch took the form of a seminar held in Los Angeles in May 2012. The REWG operates within the IAA Statutes and Internal Regulations and makes recommendations for



The actuarial profession has a responsibility to help humanity face the challenges that climate change poses to our society and way of life.

consideration by the IAA Scientific Committee as appropriate.

As required to carry out its role and activities, the REWG liaises with similar entities in local actuarial associations as well as with external stakeholders. It shares with the working groups on mortality and population issues information regarding environmental developments and initiatives that can have effects on the work of these two groups and liaises with other IAA committees, working groups or sections. Support has been expressed to the education committee for proposed additions to the IAA Syllabus regarding sustainability and climate change.

One of the objectives of creating a working group at the IAA level is to stimulate

the creation of similar entities (work groups, committees, sections) at the level of local or national associations. At that time, local entities were known to exist in Australia, Canada, the United Kingdom and the United States, although individuals were active in other FMAs. Even though distinct entities have not been formally created in many other FMAs, it has stimulated interest toward climate issues in many associations. Thus, the objective is partially met through the increase in the number of actuaries participating as members or observers in conference calls or face-to-face meetings. A significant number of associations have members in the REWG that also include a representative of the IAA ASTIN Section. Over the years, activity reports have been made on behalf of FMAs in Ireland, France, South Africa, Finland, Japan and Jamaica. With more than 60 members and observers, the REWG is, de facto, a forum for the exchange of information.

Through the REWG, the IAA is a supporting institution of the United Nations Environment Program—Finance Initiative, Principles of Sustainable Insurance. The IAA sent an application to become an observer at the United Nation Framework Convention on Climate Change (UNFCCC), the UN agency that is responsible for managing the annual meeting of the Council of Parties (COP). Its 2015 meeting resulted in the Paris Agreement. The application is still pending subject to confirmation of the

nonprofit status of the IAA. Nevertheless, a formal letter of support was sent to the UNFCCC on behalf of the actuarial profession ahead of the COP 21 meeting in Paris.

The REWG is providing:

- » Support to the Warsaw International Mechanism for Loss and Damages created by the COP to help implement approaches to mitigate the impacts for climate change
- » Detailed comments to the Bloomberg Task Force on Financial Reporting of the Financial Stability Board
- » Input to the European Union High Level Expert Group report on sustainable finance
- » Comments on an OECD Disaster Recovery paper
- » Communication channels with International Social Security Association (ISSA) and the World Meteorological Organization (WMO)

Presentations are to be made in June 2018 at the International Congress of Actuaries in Berlin with regard to recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), and on issues addressed in a recent climate change and mortality paper. This paper, developed by a subgroup and approved by the Scientific Committee, was presented at the Mortality and Population Issues Symposium last October in Chicago and was published in November 2017 on the IAA website. A synopsis of this paper can be found beginning on page 34 of this issue of *The Actuary*.

The REWG has submitted to the Scientific Committee a project of periodic communications through the IAA website reporting on the progress in controlling greenhouse gasses (GHGs) in the atmosphere compared with goals set forth in the Paris Agreement. The publication could be in the format of a press release to be used also by FMAs to promote awareness of the challenges arising from global warming. Increasing the public outreach would support the recommendations of the TCFD in favor of greater transparency in climate disclosures.

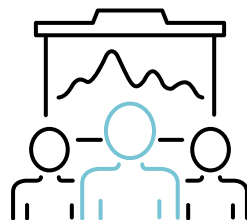
Small teams or subgroups are driving various ongoing projects, including:

- » **Carbon pricing/decarbonization.** A project with the aim of developing a relatively short report.

- » **Vulnerable populations and insurance.** A monograph developed in collaboration with the Micro Insurance Working Group.
- » **Flood risks.** A paper, not nation-specific, but similar to one published by the American Academy of Actuaries (the Academy).
- » **Government budgetary impact.** This is an extension of TCFD requirements to the public sector since every government in the world ought to be looking at climate-related future costs in some way, in a manner similar to long-term social insurance programs. If this is done consistently, it could reframe the larger climate change debate; but at the moment, most of these future cost pressures are not yet visible.
- » **Triple bottom line.** Environmental, social, governance (ESG) issues that should lead to a series of reports. Another similar project, a literature review focusing on new economic readings, is being discussed internally through a separate listserv before highlights become available through the website.

The REWG discussed the possibility of developing an Environmental Management System (EMS) for the IAA that could be cloned by other actuarial organizations. The conclusion is that the IAA staff is too small, and that the REWG should rather piggyback on efforts undertaken by the Institute and Faculty of Actuaries (IFoA), which is working on an EMS for itself. That represents a good application of the subsidiarity principle. The REWG will follow this effort and hope to leverage the results for the benefit of other associations.

The REWG website and virtual library are part of the IAA website, and in conjunction with the IAA virtual library, facilitate access to material and information related to climate change and sustainability issues by actuaries and the public in general.



The International Actuarial Association’s Resources and Environment Working Group liaises with similar entities in local actuarial associations as well as with external stakeholders.

Regional Activities

An example of activities coordinated at the regional level is a joint initiative of four major North American actuarial associations started in 2010 resulting in the quarterly publication of a unique Actuaries Climate Index (ACI). An Actuaries Climate Risk Index (ACRI) is also in development (read more about this in “Turning Up the Heat,” from the December 2017/January 2018 issue of *The Actuary*. Actuarial associations



in other geographical areas have expressed interest in extending the scope of the ACI/ACRI, or developing a local index for additional segments of the planet.

In 2010, the four associations commissioned Solera Solutions, a Canadian private research firm specialized in assessing risk and developing strategies for climate change adaptation and mitigation, to prepare the research study, “Determining the Impact of Climate Change on Insurance Risk and the Global Community.” The authors are three Canadian scientists involved in a variety of environmental activities. Obviously, the decision is the outcome of internal preliminary work done over many months by the respective associations and discussions to define the scope of the project.

Actuaries from all four associations are active members of the two joint committees that support the development of the ACI/ACRI: the Climate Index Work Group (CIWG) and the Index Diagnostic Team (IDT). The quarterly ACI press releases issued since November 2016 mitigate the necessity of other activities to sustain awareness of climate issues

and push actuaries to continuously update their climate literacy. Despite the major investment in time and effort as well as out-of-pocket expenses in this major undertaking, the four FMAs continue to conduct distinct climate-related initiatives at their local level, focusing on different aspects.

American Academy of Actuaries (the Academy)

The Academy conducts climate activities through its Property/Casualty Extreme Events Committee. Successive editions of its magazine, *Contingencies*, feature articles on climate-related issues, including a cover story on rising sea levels.

A December 2016 publication, “Essential Elements, Making Complex Public Policy Issues Clear,” focuses on extreme events. A major contribution of the Academy in March 2017 was the publication of a 100-page monograph, *The National Flood Insurance Program: Challenges and Solutions*, written by its Flood Insurance Working Group. It contains an entire chapter on rising sea levels.

The Academy held a Capitol Hill briefing on flood insurance, and in August 2017, it submitted a letter to the U.S. Senate Committee on Banking, Housing and Urban Affairs discussing 11 issues regarding flood insurance legislation.

Canadian Institute of Actuaries (CIA)

The Climate Change & Sustainability Committee (CCSC) dates from April 2014. Presentations on climate issues are made by the committee at each annual meeting as well as periodic CIA Board meetings.

The resource page on the CIA website and a public policy statement recognizing the anthropogenic contribution to climate change both date from 2015. An expanded public statement is being prepared for 2018, and it will cover climate change impacts on life and property and casualty insurance, investments and pensions.

A major research report, “Climate Change and Resource Sustainability: An Overview for Actuaries,” published in July 2015, is used to inform the membership about the wide range of climate issues. It is available for actuaries and visitors to the website. Education guidelines are planned as a follow-up starting in 2018.

The CCSC made a submission to the Ontario Ministry of the Environment and Climate Change in 2015, presented on the role actuaries should play to the Natural Resources Canada Symposium in April 2016 and responded to the consultation of the FSB Task Force on climate-related financial disclosures in February 2017.

Since 2014, the CCSC has organized a one-day Educational Forum, sponsored or co-sponsored five sessions, and

presented four webcasts to the membership, in addition to a webinar on the ACI/ACRI.

In November 2017, a presentation was made at COP23 on the role of the Information and Communications Technologies (ICT) sector in climate adaptation. The CIA also participated in the UN Environment's Principles for Sustainable Insurance Initiative (PSI) and Munich Re event, Shaping the Sustainable Insurance Agenda in North America, in Princeton, New Jersey.

Since the CIA is officially bilingual, the research paper and many of the presentations, including the ACI, are available in both English and French. Thus, the CCSC has expanded its outreach beyond Canada to French-speaking actuaries in other countries.

Casualty Actuarial Society (CAS)

The primary purpose of the Climate Change Committee (created in November 2008) is to recommend, support and perform research on climate change and assess the potential risk management implications for the insurance industry. The CAS focuses on education and research in the nonlife area, which includes extreme climate events such as floods, hurricane and drought. The professional interests of its members are a natural match for global warming and other consequences of climate change.

Over the last few years, the CAS publications, *Variance* and the *E-Forum*, include a number of articles on climate change, namely "Incorporating Spatial Dependence and Climate Change Trends for Measuring Long-term Temperature Derivative Risk," and eight papers resulting from the 2013 Climate Change Call for Essays.

In addition, many presentations on various aspects of climate change, including insurance response, risk management, CAT modeling, severe weather, green consulting and other topics have been delivered at CAS seminars and meetings. They remain available on the website.

"Where Home Insurance Meets Climate Change: Making Sense of Climate



The primary purpose of the Casualty Actuarial Society's Climate Change Committee is to recommend, support and perform research on climate change and assess the potential risk management implications for the insurance industry.

Risk, Data Uncertainty and Projections" is a research project funded by the Climate Change Committee. The research paper is under review by the CAS *Variance* editorial staff.

As of November 2017, the committee is reviewing five papers received pursuant to the 2018 Climate Change Call for Papers.

Society of Actuaries (SOA)

The SOA focuses on education and research. The article, "Determining the Impact of Climate Change on Insurance Risks and the Global Community Phase 1: Key Climate Indicators," has been on its website since November 2012. With work on climate risks ongoing for many years, the Climate Change and Environmental Sustainability Research Committee was formally established in 2015.

The SOA is working on several research projects, and several literature reviews are posted on its website. Two repositories of information relevant to actuaries are posted under the headings "Climate Sources for Actuaries" and "Climate, Weather and Environmental Sources for Actuaries." A paper covering social discounting is expected to be available early in 2018.

While it highlights primarily Canada and the United States, the SOA is offering its exams to a large number of candidates around the world. Thus, the geographic outreach extends to other countries, which abates the lack of specialized resources in many smaller associations to address climate issues adequately. ■

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BY STEPHANIE C. HERRING

OBSERVING MOTHER NATURE

A look at severe weather events in a changing climate



In 2017, the United States experienced record flooding from Hurricane Harvey, Hurricane Irma set record wind speeds, extreme wildfires spread across the Western United States, massive ocean heat events off the coast of Alaska continued to impact the U.S. fishing industry, flooding occurred in California and hail storms hit Colorado, just to name a few extreme events. In total, the United States experienced 16 weather and climate disaster events in 2017, with losses exceeding \$1 billion each (see Figure 1). In addition to the high frequency of last year’s extreme events is the cumulative cost, which exceeded \$300 billion in 2017, a new record.

Extreme events can have extraordinary socioeconomic and environmental consequences that can alter communities and the landscape for years after the event. Of course, these events aren’t new. Extremes have been affecting the Earth since the

beginning of time and will continue to be a fact of life. Given that extreme events are here to stay, the next question for our society is, what should we do about them? How do we prepare and build resilience to these events and mitigate their impacts on people and property? The answer to this depends in part on what we think the future holds for extreme events. Will they become more or less likely? More or less intense? Occur in new locations? Scientists have long studied these questions, and evidence is mounting that a new driver is impacting how extreme events will change in the future. The evidence that human-caused climate change is affecting the intensity, frequency and geographic distribution of some extreme event types is now undeniable.^{1,2,3,4} Quantitatively connecting the impact of human-caused climate change on extreme events is the focus of the field of *climate change event*

Figure 1 2017 Billion-Dollar Weather and Climate Disasters in the United States



Source: NOAA National Centers for Environmental Information (NCEI) “U.S. Billion-Dollar Weather and Climate Disasters” (2018). <https://www.ncdc.noaa.gov/billions>.

attribution. Event attribution examines whether climate change played a role in altering the risk of a specific event through a probabilistic approach similar to what is used in public health. This article explores the state of the knowledge for how climate change is impacting extreme events and how this information can be used to reduce risk exposure.

Not All Extreme Events Are Created Equal

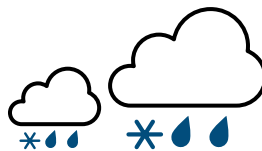
A discussion of extreme events must first begin by clarifying the term “extreme events.” They represent a category of the most extreme weather and climate phenomena, but are individual types of events (i.e., heat, precipitation, drought, hurricanes). Each event type is unique, and our scientific understanding varies by event type. Much like the term “cancer” is a catchall for a group of diseases involving abnormal cell growth, the science, treatment and impacts of different cancer types vary greatly.

Extremes related to temperature and sea level rise are ripe for event attribution because the impact of human-caused climate change on these is well established, and scientists have a strong understanding of how climate change is expected to impact sea levels in the future. For example, it was found that climate change made both the storm surge from Hurricane Sandy worse in 2012 and has increased floods caused by high tides by more than 500 percent off the coast of Miami in the past two decades.^{5,6} Daily tidal flooding is accelerating in more than 25 Atlantic and Gulf Coast cities.⁷ Storm surge and tidal flooding, and the economic costs associated with these events, are expected to worsen under future climate change. Heat extremes are regularly found to be exacerbated by climate change. For more on the public health impacts, see the article by Sam Gutterman on page 34.

Precipitation is another area where evidence is mounting that extremes are on the rise due to climate change. Because



Climate change made the storm surge from Hurricane Sandy worse in 2012, and it also has increased floods caused by high tides by more than 500 percent off the coast of Miami during the past two decades.



The number of extreme two-day precipitation events has increased by 74 percent in the Northeast United States during the past century.

a warmer atmosphere holds more water, precipitation events are on average expected to increase in intensity by about 6 to 7 percent for each degree Celsius of temperature increase, but this varies by location. In the United States this has translated into a rise in extreme precipitation events, especially in the central and eastern states. For example, the number of extreme two-day precipitation events has increased by 74 percent in the Northeast over the past century.

The annual *Bulletin of the American Meteorological Society* report “Explaining Extreme Events” has now looked at more than 130 extreme events from around the world over the past six years. Events examined range from the most common land and ocean temperatures, precipitation, and drought, to events such as forest fires, melting sea ice, extreme sunshine, hurricanes and winter storms. About 65 percent have found a role for climate change on the associated event, while 35 percent did not. Even when a role for climate change is not found, it doesn’t necessarily mean that climate change didn’t contribute in some way. It could mean that the tools currently available don’t allow for the signal to be identified, and as our scientific understanding grows stronger, future work could reveal additional information and understanding.

How Does Event Attribution Work?

The National Academies of Sciences, Engineering and Medicine recently published a detailed analysis of event attribution methodologies.⁸ One of the most common methods to calculate the change in risk of an event due to human-caused climate change is to employ a statistical approach originally developed in public health called the fraction of attributable risk (FAR).

In public health, for example, this would be used to assess how smoking increases your chances of lung cancer. By comparing cancer risk in a cohort of patients who

smoke to cancer rates in a control group of nonsmokers, researchers can determine how much smoking increases the risk of lung cancer.

In event attribution, scientists start by determining the probability of an event (such as a heatwave) occurring in the presence of human-caused climate change. This represents the world we live in today, and the event's probability is usually established by our observations of Earth's system. This is then compared to the probability of the event occurring if human-caused climate change had not been present in the world. Since we only have one planet and cannot do a true "control," this alternative world is based on model runs of a world that only includes natural climate forcing mechanisms and ignores changes driven by human greenhouse gas emissions. By comparing the probability of the event in the existing world with a world that might have been, the change-in-event probability can be quantified.

Events "Not Possible" Without Climate Change

The most recent, and perhaps notable, development in event attribution has been the emergence of events found "*not to be possible*" without the influence of human-caused climate change. In the report "Explaining Extreme Events of 2016 from a Climate Perspective," which was released in December 2017, researchers examining three different events concluded they were not possible in a world without human influences on the climate.

In a paper analyzing the 2016 global heat record, researchers concluded that the record global warmth "was only possible due to substantial centennial-scale human-caused warming."⁹ A second study investigating the record heat over Asia found that the extreme warmth across Asia in 2016 "would not have been possible without climate change."¹⁰ And, finally, researchers studying a large, persistent area of anomalously warm ocean water off the coast of Alaska found "no instances of 2016-like anomalies in the preindustrial climate" for sea surface temperatures in the Bering Sea.¹¹

While remarkable, these results are not surprising. Scientists have long predicted we would eventually reach a point where human-caused climate change altered Earth's system to such a degree that we would begin to see weather and climate events that would not have been possible without human contributions. It was also predicted that these first events would be related to high temperatures in the ocean and atmosphere, where the impact of human activity on our climate is most strongly observed.

What does it mean when stated that an event was not possible without human-caused climate change? It is important to remember that every event is still built on a foundation of natural variability. This includes the types of drivers that your local broadcast meteorologist highlights on maps during the evening news, including atmospheric circulation patterns of highs, lows, blocking events, La Niña and El Niño, sea surface temperature and so on. So it is likely that 2016 would still have been warm globally, but with the added influence of human-caused climate change, the temperatures surpassed a threshold they otherwise couldn't have. The building blocks for the event were laid by the types of drivers that normally cause heat events to occur, but climate change pushed the event to reach temperatures it otherwise could not have.

Understanding Impacts and Informing Risk: The Emerging Discipline of "Impacts Attribution"

In recent years, interest has been growing in the area of "impacts attribution," which aims to draw a line connecting climate change to the altered risk of an extreme event and the subsequent impact of the event. Impacts attribution increasingly is being recognized as the next major area of advancement for attribution science to enhance the field's ability to connect to indices relevant to people. Impacts from extremes are determined not just by the event itself, but also by the vulnerability of the people and assets exposed to the event. By improving our understanding of how extremes are changing, governments, planners, businesses, communities and individuals can improve their preparedness and minimize the costs of these events.

The first paper to do this for human health was published in 2016 when attribution scientists partnered with



public health officials to assess the role climate change played in increased mortality from a specific event—the 2003 European heatwave.¹² Their results concluded that in the summer of 2003, “out of the estimated ~315 and ~735 summer deaths directly attributed to the heatwave event in Greater London and Central Paris, respectively, 64 (+/-3) deaths were attributable to anthropogenic climate change in London, and 506 (+/-51) in Paris.” For the first time, a methodology had been established for connecting climate change to the mortality of a specific heat event. Clearly, multiple approaches could be taken to address these questions and the paper lays out just one, but it was an important first step in quantifying the impact of climate change on health outcomes.

An area of active research has been to link specific heat events to health indicators such as insurance claims and hospital admissions. The goal is to help us better understand which heat events are having significant health impacts, and then to assess whether these events are expected to increase due to climate change—that way we can inform public health responses to heat events in the future. For more information about how climate change is expected to affect public health, see the article by Jesse Bell on page 56 of this issue.

Drawing connections to environmental impacts is also an area where research is beginning to emerge. For example, in a study of the 2016 extreme Great Barrier Reef bleaching event, researchers concluded the risk of the extreme event was increased through anomalously high sea surface temperature and the accumulation of thermal stress as a result of human-caused climate change.¹³ Two other papers authored by NOAA scientists showed how rising ocean temperatures, caused in part by human-caused climate change, impacted living marine resources and were linked to coral bleaching, reduced fish stocks and a decrease in seabird counts in the California current and the equatorial Pacific.^{14,15}

While these papers represent early approaches, they are important first steps in improving our understanding of how climate change has, and is expected to, impact important socioeconomic outcomes including public health, the environment, infrastructure and the economy more broadly. This work will continue to be important in exploring ways to enhance our resilience to future extreme events and to minimize the impacts of extremes on our economy and society. ■

Statements of fact and opinions expressed herein are those of the individual author(s) and are not necessarily those of the Society of Actuaries or the respective authors' employers.

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BY SAM GUTTERMAN

The Vulnerable

Why actuaries need to develop new tools, techniques and insights to provide a reliable guide to navigate the effects of future climate developments

Editor's Note: This article is based on an International Actuarial Association (IAA) Working Group Discussion Paper.

C

Climate change will have a wide-ranging global impact. Future changes will in some way impact the population of all countries and in all socioeconomic categories. These impacts include health and quality of life, property and the environment—with dramatically diverse results by geographic area and population segments. One important type of impact worthy of study is the mortality of the population, which is the focus of a paper¹ made available in November 2017 by the International Actuarial Association's Working Group on Resources and Environment.

The climate process is complex and ever changing. It is made up of many elements, including temperature, humidity and precipitation. The long-term trends involved will continue to affect many aspects of human life, both directly and indirectly.

The analysis of and actions related to the process of climate change, from causes to potential damages, is a perfect example of a social risk management process. The process includes the study of underlying causes; for example, greenhouse gas emissions, the interrelationship between these causes and damages, the analysis of economic/actuarial damages, and possible mitigation and adaptation actions. The remainder of this article will examine this process with respect to mortality damages.

It is useful to categorize its impacts into sudden and slow onset types. Examples of the former are storms, heat surges and extreme weather events; examples of the latter include sea level and water quality, desertification and deglaciation. Although it is common to focus on these big news developments, often the secondary and indirect effects can be just as crucial in climate impact assessments and also need to be addressed.

There are many contributing factors affecting long-term weather patterns.

Scientific observations have shown that the relatively recent (over the last 150 years, but especially the last 50 years) and continuing increases in accumulated greenhouse gases (e.g., carbon dioxide and methane) in the atmosphere and oceans contribute to some fairly radical changes in long-term climate effects.

The Vulnerable

The at-risk populations are especially important to examine. Those particularly vulnerable to mortality risk differ by each of the dimensions of climate change (see Figure 1 on page 37 for key examples). Those most at-risk of excess deaths due to disease tend to live in zones closer to the equator, coincidentally where the weakest

The analysis of and actions related to the process of climate change, from causes to potential damages, is a perfect example of social risk management process.

health infrastructure exists. Those most at-risk due to heat-stress tend to live in areas more exposed to seasonal heat surges (those in areas used to cold conditions may benefit from higher temperatures, while the non-vulnerable living in hotter conditions all year long have steeled themselves to excessive heat already). Although those living next to an ocean will be exposed to gradual sea level rise, those who can afford to should have sufficient time and resources to prepare for it; excess mortality risk will tend to be of a secondary or tertiary nature that occurs primarily after emigration from the coast.

Vulnerable populations often have access only to at-risk medical infrastructure (this infrastructure may be weak in the first place), with no accessible backup to provide for times of extreme health risks. This creates or exacerbates the risk to these vulnerable populations. This risk was experienced during the immediate aftermath of Hurricane Katrina in Louisiana in 2005.

Those who are less well-off may be adversely affected partly because they have less access to affordable living conditions and support. For example, when drought, famine, sea level change, conflicts or other extreme conditions occur, they may not be able to afford to move into non-at-risk areas or housing. Housing and access to proper medical care for those with low or no income tend to be of poor quality, with resultant exposure to disease and malnutrition. Those with lower income cannot afford to live or work in resilient structures. Even after a natural disaster occurs, due to affordability concerns, they will often just move back and re-expose themselves to the same hazard.

The very oldest and youngest members of a population may be most at risk to many mortality hazards emanating from climate change. The frail will often be among the most affected in times of weather extremes, particularly in heat surges where the elderly are among the most vulnerable. The youngest who are most at-risk to such climate-related conditions such as diarrheal disease and food insecurity will experience stunting, arising from malnutrition.

Climate Change

Two major elements of climate are temperature and precipitation:

» **Temperature.** This is most commonly referred to in this context as global warming. Possibly the most advertised effect of climate change is the effect on average and extreme (volatile) temperatures, influencing many facets of air,

water and land surface temperatures. The frequency of extreme heat has become increasingly common, as well as decreases in extreme cold. It appears that in recent decades both record average global temperature and heat waves have become more common.² Warmer temperatures increase water evaporation, while warmer water can increase the severity of extreme storms such as hurricanes, whose genesis or trajectory is over an ocean.

» **Precipitation.** Changes in precipitation can lead to more intense individual downpours or drawn-out drought conditions. Excessive precipitation can result in flooding and soil erosion with deadly results. Droughts in already arid regions may continue in duration and may spread and increase in severity. Water scarcity in areas in which vulnerable populations reside will adversely affect human health and mortality. These very different climate patterns will vary by geographic area and may vary by time period.

Humidity, barometric pressure and ultraviolet radiation that reach extreme and damaging conditions will add to the harm, especially when acting together. For example, drought conditions have caused significant public health catastrophes, resulting in mass migration, malnutrition, poor living conditions and increased deaths in areas such as Eastern Africa. Although short-term exposure can be bad enough, adverse results from multiyear drought conditions are not restricted to what people drink. They also extend to what is eaten, as the human activity that consumes the most water is agriculture, the source of income and food to many.

Although many think of climate change in terms of something that will start snowballing sometime in the distant future, some of its effects are already upon us. Increases in both the frequency and severity (including their financial effects, which will increase in the future as populations both increase and become further urbanized)



The very oldest and youngest members of a population may be most at risk to many mortality hazards emanating from climate change.

of extreme natural events appear to be present already and will likely continue to worsen. These include tropical cyclones (although the frequency of landfall in North America may not increase), tornadoes, floods, windstorms, wildfires, drought (in extremes—famines) and heat waves. These not only affect mortality, but also can cause infrastructure and property damage, with consequential injuries and sickness.

Mortality Consequences

The World Health Organization (WHO)³ estimated that some 12.6 million deaths globally are attributable to the environment (overall—not restricted to that due to climate change), which is about 23 percent of all deaths. Clearly environmental deaths need to be assessed.

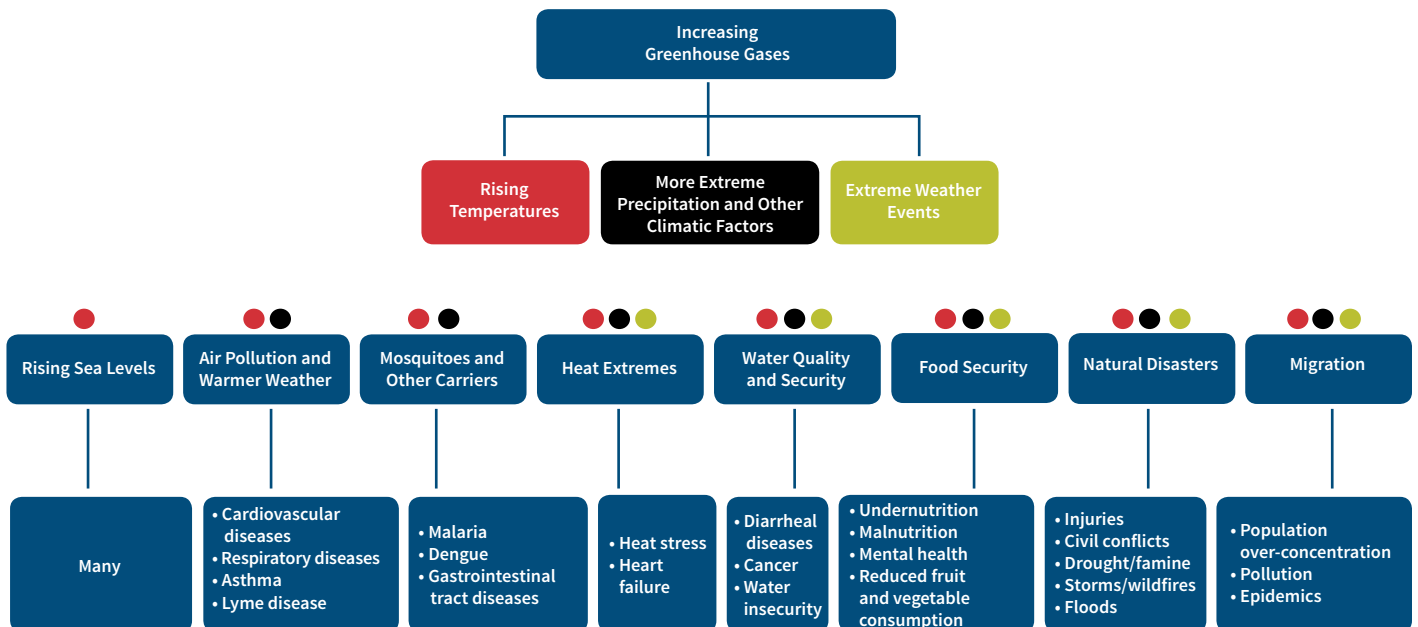
Some premature deaths have been shown to be directly due to climate change, while others are indirect consequences (both included in Figure 1). In almost every recent assessment of what seems to be an increasing frequency of natural disasters around the world, an ever-present question is: What is the contribution of climate change to the resulting damages? The developing

scientific field of attribution analysis is attempting to answer this question.

Although there is insufficient space in this article to dig into the details of this type of analysis, it is anticipated that as our climate continues to change, this type of questioning will remain important, in part to spur public and private sector involvement in efforts to mitigate and adapt to the changes that will inevitably occur. Although many premature deaths will be due to climate change, certainly the percentage will differ dramatically by cause.

The challenges in estimating these percentages is partly the result of the wide and complex range of interacting causes and effects of climate, which differ by area and population segment. An example is the ever-changing patterns of disease from sources such as certain strains of mosquitoes, drought and famine, conflicts, storms and wildfires, and slow-onset conditions that in turn may lead to migration of vulnerable populations and to high population densities. The process and adverse factors involved are summarized in Figure 1, starting from first-order factors in the first and second rows to the first-order effects in the third row and immediate causes of death and ill-health in

Figure 1 Adverse Effects on Mortality From Climate Change



the last row. There are significant interactions among the factors in the second row and between the factors and their effects in the third and fourth rows.

Diseases that have been shown to be affected or caused at least in part by climatic factors include:

- » **Diarrheal diseases.** Many deaths are due to low water quality, especially affecting children under the age of 15. By 2030 the WHO⁴ expects 48,000 annual deaths, especially in Southern and Eastern Asia.
- » **Malaria and dengue.** These diseases are derived in part from increased temperature, which in turn increases the frequency of mosquito bites. By 2030 the WHO expects about 60,000 annual deaths to be due to climate change, offsetting what until recently has been a significant decrease in deaths due to these causes.
- » **Gastrointestinal tract illness and infection.** The number of these deaths in part has been driven by increased water temperature.

- » **Asthma.** Increased temperature, humidity and dust (from droughts and erosion) contribute to increased pollen, mold and air pollution, with resultant increased deaths.
- » **Cardiovascular and respiratory disease.** Increased temperatures and their volatility will contribute to deaths due to heat stress and air pollution, particularly affecting the aging population.
- » **Cancer.** Deaths due to climate change will in part be due to increased ultraviolet radiation.

The United Nations Office for Disaster Risk Recovery (UNISDR)⁵ expects about 38,000 deaths in 2030 (about 95,000 in 2050) from natural disasters, especially among the elderly. Half of these are expected in Southern and Eastern Asia, with about 10 percent in high-income countries. Alan Barreca⁶ found that, in the United States, each additional day of extreme heat (more than 90 degrees Fahrenheit) increased mortality by about 0.2 deaths per thousand, or about 0.02 percent, while reported mortality effects of extreme cold appear to be driven more by low humidity than by cold temperatures.

It is important to note that, although many additional deaths are directly and indirectly attributed to climate change due to extreme weather conditions, not all are.

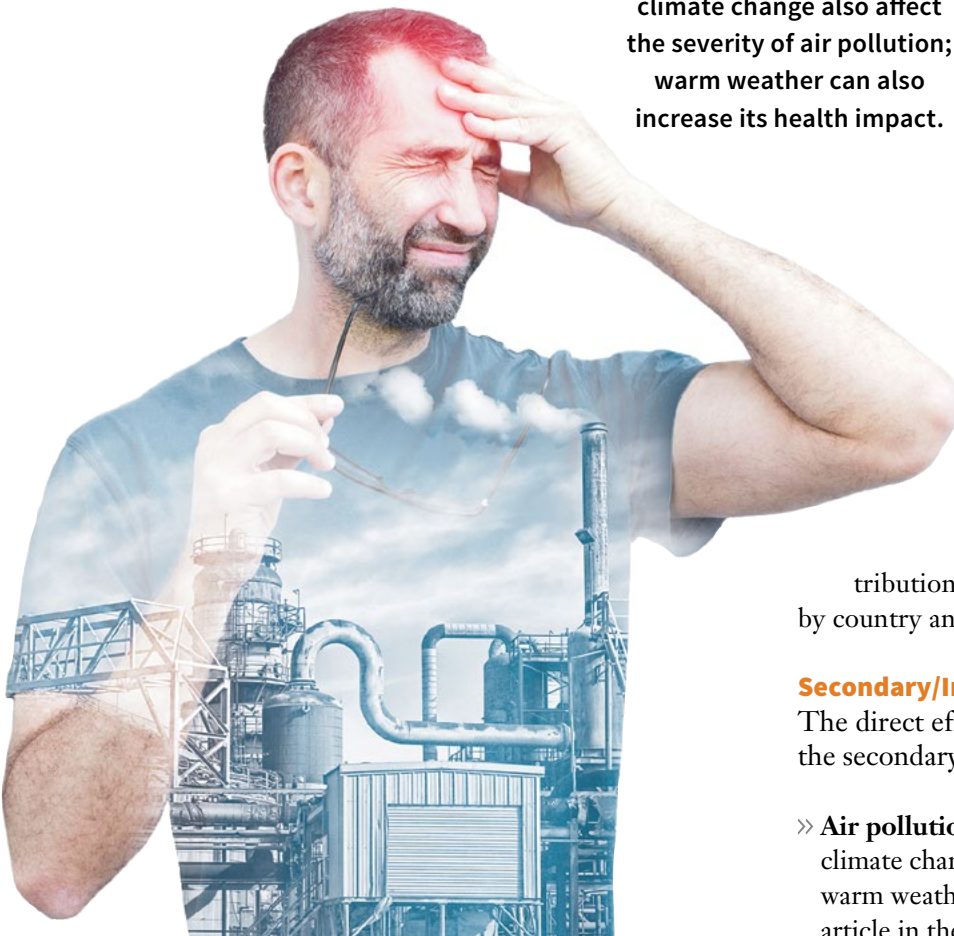
Although adverse trends are generally associated with extremes, some of the worst mortality effects are associated with moderately adverse trends. Based on an extensive search of the literature, a 2015 article in *The Lancet*⁷ found that, despite the attention given to extreme weather events, most of the effects happened on moderately hot and moderately cold days, especially moderately cold days. The percentage contribution of hot/cold conditions differs dramatically by country and even within countries.

Secondary/Indirect Effects

The direct effects on mortality can be bad enough, but the secondary effects can be killers as well. They include:

- » **Air pollution.** Some of the same contributing causes of climate change also affect the severity of air pollution; warm weather can also increase its health impact. A 2015 article in the journal *Nature*⁸ estimated that premature

Some of the same contributing causes of climate change also affect the severity of air pollution; warm weather can also increase its health impact.



deaths worldwide from outdoor air pollution will increase from 3.3 million per year in 2010 to 6.6 million per year by 2050 (about 12 percent of total deaths) if nothing is done to improve air quality. The main sources of CO₂ emissions (e.g., the extraction and burning of fossil fuels) are key drivers of both climate change and air pollution. Based on an experience study of the U.S. Medicare population from 2000 to 2012, a 2017 article⁹ found that short-term exposures to small particle pollution and warm-season ozone were significantly associated with increased risk of mortality. This risk exists at levels below current national air quality standards, suggesting that these standards may need to be reevaluated.

premature death, which in turn can be passed on to the next generation.

» **Severe weather conditions.** Climate change has contributed to the severity of many, but certainly not all, natural disasters.

As with direct causes, it is not claimed that all of these deaths are due to climate change. Nevertheless, many (or the same underlying causes) can be attributed to it.

Favorable Effects

Not all the effects of climate change are adverse. Beneficial effects can also occur as a result of direct climate change itself (e.g., warmer winter temperature may reduce the number of cold-related deaths,

One of the most substantial health effects of climate change is expected to be undernutrition and malnutrition causing 95,000 deaths per year in 2030, according to the World Health Organization.

» **Food and water insecurity.** One of the most substantial health effects of climate change is expected to be undernutrition and malnutrition causing 95,000 deaths per year in 2030, according to the WHO. However, “Global and Regional Health Effects of Future Food Production Under Climate Change: A Modelling Study”¹⁰ indicated that the composition of future diet may have a greater impact than all the climate factors considered by the WHO combined. Twice as many climate-related deaths were associated with reductions in fruit and vegetable consumption than with climate-related increases in the prevalence of malnutrition. Undernutrition and malnutrition at an early age can have long-lasting effects, including increased risk of illness and delayed mental development and

more efficient agriculture due to warmer temperature or changing crop patterns may reduce food insecurity in some areas) and from mitigation activities (e.g., increased use of air conditioning may reduce deaths resulting from extreme heat conditions).

In addition, co-benefits may arise from the efforts to adapt to climate change. For example, many deaths have been spared as a result of enhanced planning in anticipation of some aspects of climate change. It has been estimated that there were almost 15,000 deaths in Paris associated with its heat wave in 2003. Comparable heat waves were experienced in the subsequent decade, but fewer deaths resulted because of better preparedness of the public, health infrastructure and enhanced emergency procedures. The moral is that some of the adverse consequences to climate change



can be offset by effective mitigation programs, which may also be accompanied by co-benefits.

Quantitative Analysis

Modeling the possible impacts of climate change and different future climate scenarios on future levels of mortality presents formidable challenges, in part due to the interconnected nature of the systems and the uncertainties. Both stochastic modeling and scenario analysis (stress testing for the tails) can provide valuable insights into the extent and characteristics of the populations primarily affected.

It is anticipated that many risks associated with climate change will increase over time. As a result, more of the effects on mortality will be felt by most insurance and pension plans over the long term, rather than during the immediate future. The adverse mortality effects may not be as noticeable as those from other factors, although some will tend to occur in bunches (offering an excuse to discount or ignore them as outliers) significantly affected by concentration risk, especially in areas of the world where those who are vulnerable reside.

Two main methods have been used to study the effect of heat stress:

❶ | Study of specific causes of death directly attributed to heat stress, especially of the period immediately after the stressed conditions. Due to the difficulty in obtaining this type of information, this approach's results may understate the resulting number of deaths.

❷ | Statistical analysis of trends in or excess of seasonal or situational all-cause mortality. Although many other factors can influence the number of these excess deaths, the correlation and trend over time between such excess deaths and extreme temperature conditions can provide useful insight into its effects.

A case study in the International Actuarial Association (IAA) paper that is the basis for this article addresses the effects on mortality of warmer temperatures in the United Kingdom. Its conclusion is that fewer deaths may result from climate change in the United Kingdom, as the favorable effect of warmer winters may more than offset the adverse effect of hot summers. A major benefit of this case study is the analytical process described—a rigorous application of the scientific method.

However, the IAA paper also points out that the U.K. findings cannot be generalized. Various studies have indicated a net increase in deaths will be likely in much of the rest of Europe. In areas of the world such as India, a significant adverse mortality risk exists—over the last 50 years a substantial increase in mass heat-related deaths (100+ deaths) has occurred. With increased urbanization, the severity of the impact of extreme events has increased. A 2017 report shows that between 2000 and 2016, the number of people exposed to heat wave events increased by about 125 million people.¹¹ This will remain a problem.

It is also important to realize that in certain parts of vulnerable populations, such as the frail elderly and the disabled, some of the deaths associated with climate change (due to, for example, heat surges) may simply be

deaths that have moved forward or been “displaced” by a matter of a few days or months.

Why Should Actuaries be Concerned?

Since most of the areas in which actuaries are more active (e.g., private and public sector insurance, annuity and pension programs) tend to focus on what are considered to be nonvulnerable populations, the direct effect on mortality in these programs may not be as significant as for the entire population, especially its most vulnerable segments. In addition, other factors, including changes in medical treatment and infrastructure, lifestyle and aging, will likely have a far greater effect on mortality than climate change in most population segments where actuaries are involved.

A great deal of uncertainty exists with respect to climate change—not regarding whether climate change exists or who is responsible, but to the extent, timing and severity of resulting damages. This uncertainty arises due to the fact that we have not experienced the types of climatic conditions that may arise and the effectiveness and timeliness of future human intervention. Many aspects of climate change are difficult to estimate; examples include hurricane trajectories, severity of famines, speed of deglaciation and climatic feedback loops, especially caused by clouds. Especially uncertain is the volatility of damages, due to the ultra-long time horizon involved and low-frequency/high-severity nature of some of the possible tail risks. Unfortunately, most new insight has led to more adverse projections.

This is clearly an area in which actuaries need to develop new tools, techniques and insights, as extrapolating historical



As these broader effects of climate change become more observable and more important in overall risk management, actuaries will be increasingly asked to assess the effect on the risks in areas where they are involved.

trends will not provide a reliable guide to future developments. Detailed work will be required both in developing such tools for global use by the profession, and at the local level in applying them to the analysis of the specific set of circumstances of a region or area. It is especially challenging because of the difficulty in interpreting historical experience (due to widely diverse conditions) and inconsistency in reporting around the world.

In conclusion, for many population segments that benefit from actuarial work, the short-term impact will likely be limited and will be overwhelmed by other mortality risks. Nevertheless, in some markets and countries with significant vulnerable pop-

ulations, the direct and indirect effects may be substantial. As these broader effects of climate change become more observable and more important in overall risk management, actuaries, as professionals and members of society, will be increasingly asked to assess the effect on the risks where actuaries are involved. Our clients will want to enhance their understanding of the impact of climate change on their businesses, so actuaries will need to keep on top of future developments. It demands future research and consideration. ■

Statements of fact and opinions expressed herein are those of the individual author(s) and are not necessarily those of the Society of Actuaries or the respective authors' employers.

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Climate change is a subject of great nuance and substantive rhetoric, and investors are increasingly brought to task to show what they are doing about it.

Approaching Responsible Investing

Barbara Zvan-Watson of the Ontario Teachers' Pension Plan on what climate change means to institutional investing

INTERVIEW BY ROBERT BROWN



Robert Brown, FSA, ACAS, FCIA, HONFIA, co-editor for this issue of *The Actuary*, was interested in what impact climate change might have on institutional investors. He talked with Barbara Zvan-Watson, FSA, CERA, FCIA, who is the chief risk and strategy officer, Strategy and Risk, at Ontario Teachers' Pension Plan (OTPP). OTPP has assets totaling \$189.5 billion. The plan has 323,000 active and retired members.

BROWN: Tell us about reputational risk at OTPP.

ZVAN-WATSON: Our reputation and our brand are fundamental to our license to operate and our ability to invest. These have been built over years of effort, and they form the foundations for the trust that exists between our members and us, giving us the flexibility and the independence to exercise our judgment in what investments we choose to make.

Ultimately, much of what we do is geared toward maintaining our ability to make the best investment decisions for our members, to guarantee their pensions over the long term. That requires us to be both agile and prudent in our investing.

This is a journey, and while we have always considered material environmental,

social and governance (ESG) factors, over the years we have worked to evolve our organizational culture to incorporate a systematic approach to our investment process. As our approach developed, so did our confidence in providing transparency on our activities to stakeholders.

We conducted a first “education” session for members in 2011, and since then we have continued to build their knowledge of ESG factors and of our approach to responsible investing. We have published thought pieces on our website that discuss our research and analysis on climate risk, carbon footprinting, cybersecurity and other topical ESG issues.

Internally, we have worked hard to put in place systematic processes across the plan to integrate ESG risks and opportunities through building awareness and knowledge, and taking actions. This approach helps ensure that portfolio managers are thinking about these when making investment decisions.

Climate change poses numerous challenges to investing, including those pertaining to reputational risk. Climate change is a subject of great nuance and substantive rhetoric, and investors are increasingly brought to task to show what they are doing about it. Our members hear

from many that the solution lies in divestment of fossil fuels; investing in fossil fuel companies is tantamount to contributing to the causes of climate change. In our view, mitigating climate change is a lot more complicated than that and will require fundamental changes in our economic and social structures.

Reputational risk also extends to our investment partners. We want to be an attractive partner. We know that if we do not manage material/critical ESG risks well, we will be unable to gain the confidence of partners, like governments, who have entrusted us with critical infrastructure. For example, without our reputation as responsible investors, it is unlikely that the Chilean government would have allowed us to manage nearly a third of the country's water distribution.

BROWN: Let's look at ESG more broadly. What impact has climate change had on your thinking and how it fits in there?

ZVAN-WATSON: Climate change is not a single risk, nor is it only environmental risk. Rather it is a set of ESG risks that are in turn a subset of the broader universe of ESG risks.

We see responsible investing as a process or approach. We do not see it as a noun, but rather as a verb. It's how we make investment decisions, and how we manage our investments to ensure that we continue to earn the investment returns we need to meet pension payments over the years. It is called responsible investing because it explicitly considers ESG risks as part of the process.

Climate change is a broad set of risks that can affect different companies in different ways. While we may not know the nature and timing of the impact, we do know that it will reach broadly across sectors and geographies, and that it will be difficult to hedge the plan against those risks. So they need to be managed, at the company level as well as at the portfolio level.

BROWN: What are the climate change risks?

ZVAN-WATSON: Typically, we categorize climate change risks into buckets. Obviously, there are the physical risks of climate change, and those are both "E" and "S" risks. Physical risks might be—in the "E" part, extreme weather, droughts, ocean acidification—all the things that happen to the physical environment due to climate change. The "S" part of that physical risk is really about impacts on employees, customers, communities and the like. Here we are talking about phenomena like migration or social

unrest, disease, availability of clean water, and health and safety.

For instance, one of the potential risks of a warming climate is that certain disease sectors do not die off. In Canada, mosquitoes die off at the end of every year because it gets cold here. Well, what if they didn't? So now you have constant exposure to viruses that are not dying off, and they have the ability to strengthen.

Then there is transition risk, relating to actions that we as a society take in order to deal with climate change. These can include regulatory risk, carbon taxes, carbon caps and restrictions on water use. It can also include disruptive technologies. If you are a car company and you do not have an electric vehicle and everyone else does, you risk being disrupted because technology has moved to electric. Other technology risks include the movement to renewables in general. If you are coal-fired and the world is moving to renewables, you have stranded assets. Other risks come in the shape of general changes in consumer behavior. If consumers decide that climate change is something they are actively taking action against, maybe they reduce their meat consumption, or maybe they reduce their air travel, and suddenly demand for certain products changes.

BROWN: How have climate change considerations impacted your responsible investing approach?

ZVAN-WATSON: Climate change has been described by Mark Carney, governor of the Bank of England and chair of the financial stability board, as a systemic risk—meaning you can't get rid of it by diversifying companies or by ignoring certain sectors of the economy. So if we think about climate risk as a systemic risk, it changes how we operate and how we manage it because now it becomes a total fund issue.

Among other factors, broad global reactions to climate change have been catalysts to structural change, prompting an approach that is more total fund-wide rather than being managed company by company.

Other catalysts for change include recommendations from the Task Force on Climate-related Financial Disclosures (TCFD) that asset owners should also disclose their exposure to climate change, in addition to corporate disclosures. It means that the board of an asset owner, our board, must consider even more than before how they provide oversight over climate change risk at the portfolio level. I think the world has evolved to understand that climate change risk is a much broader risk that needs a different type of management.

At OTPP, we look at it from the perspective of the impacts of climate change across the plan. To do that, we launched a scenario analysis to understand the potential structural changes that can happen in the economy as a result of climate change. We then applied what we learned across the plan to understand the implications across different asset classes and across different sectors. So we have taken a much broader, a much more total fund approach to climate change considerations. This is expected to inform how we construct our portfolio, how we find and evaluate investment opportunities, and how we assess companies' preparedness for climate change.

BROWN: Has climate change caused the plan to take a long-term view of risks?

ZVAN-WATSON: The short answer is no because we have always had a long-term orientation around plan sustainability. An early warning system is in place to seize opportunities and position the plan for the future.

At the same time, long-term orientation means that you may take actions today that will pay off in the long term because it is more cost-effective to do so today. This is why, for example, our engagement with companies includes asking about emissions reductions.

As a long-term investor, we endeavor always to understand what business models have the most attractive growth prospects. With this lens, coal-producing companies or businesses that rely directly on coal are not attractive investments, but new power technologies such as micro grids and battery storage are attractive even though they are not dominant in the market.

What has become clear over time is that, even though climate change is a long-term risk, it can get priced in the short term quite quickly and rapidly. We saw that clearly with the coal companies. Coal has not been eliminated from the economy, but the re-pricing of coal that happened a couple of years ago really drove home the fact that it doesn't have to be happening immediately. If the market thinks it is going to happen eventually, it then prices that in.

Climate change has also impacted our thinking around infrastructure investments and the type of investments we look for. At OTPP, when we think of long-lived infrastructure or agricultural assets, we are thinking about positioning the portfolio for the future. That is why we invest in smart meters, which represent an important step toward a low-carbon economy. We invest in micro grids because distributed energy systems are where we think

power generation is headed. Our investment in rope-grown mussel farming is supported by the fact that it is a highly sustainable form of meat protein production. It bears emphasizing that we've always had an orientation to the long term, and that has never changed.



Our engagement with companies includes asking about emissions reductions.

BROWN: How do Canadian investors grapple with the fact that Canada is a resource-based economy, while managing climate change risks seems diametrically counter to that?

ZVAN-WATSON: We have had to be thoughtful, balanced and pragmatic in our approach to this question. While natural gas and renewables are replacing coal-fired generation in developed (and increasing in developing) nations, there is no ready substitute for oil, which based on current technology, will continue to be needed for steel-making as well as air and sea transportation. Regularly updated

models from the International Energy Association (IEA) estimate that coal, oil and natural gas continue to be a part of global energy under what we know now to be an optimistic, two-degree scenario. We have a less progressive view of coal given its impacts on air quality.

We use our influence to encourage Canadian oil companies to lead the way in making Canadian Exploration and Production (E&P) operations among the least resource-intensive, environmentally and socially impactful operations. They need to be competitive on a cost-, resource- and emissions-basis with conventional oil and gas, or risk being priced-out (stranded).

At the same time, we want to encourage policymakers and the industry to think long term and strategically about how Canada will be positioned for the Low Carbon Economy (LCE). Over the long term, the industry has to be thinking about where it's investing and about whether payback on capital expenditures (capex) is adequate and, if it is not, it needs to be considering the viability of those investments.

Ultimately, the changes required to avoid more severe climate change impacts go way beyond the extractives sector. These structural and societal changes will create winners and losers, and as a pension plan we need to be cognizant of these and manage these risks.

BROWN: Where do renewables fit into the investment equation? What is the new investment opportunity set?

ZVAN-WATSON: OTPP has long been in renewables. We invested in BluEarth renewables in 2009. We partnered with the federal Public Sector Pensions (PSP) to create Cubico Sustainable Investments in 2015. Both of these investments seek to build a portfolio of wind, solar, hydro and other renewable energy assets.

We also have investments in clean technology, such as micro grids and smart meters, two tools in the LCE transition. Recent investments in energy storage, smart meters, micro grids and renewable generation highlight our activity in this space. Going forward, we plan to expand these efforts to include other climate-smart sectors, including other forms of energy efficiency, mobility and charging, waste-to-value and alternative fuels. There are attractive

opportunities in food and agriculture amid growing demand for sustainably produced, healthy, natural food and proteins. Climate change adaptation opportunities are also arising, including technology to make buildings more energy efficient. Desalination of seawater has a very forward-looking thesis.

Climate change and actions that we take to mitigate climate change make investments like these attractive, but it does not make them free of ESG risks. Just because something is renewable, for example, does not mean we are willing to accept a lower return, and we are not going to accept a higher level of risk. If an investment relies heavily on subsidies or is in a jurisdiction that we find to be unfavorable for a long-term investment, that will weigh on our decision-making process. Where there are subsidies involved, we review the investment to make sure that the

asset is still attractive without the subsidies.

It bears underscoring again that the opportunities that come from climate change will go well beyond renewables, and that is how we need to be thinking. What are the areas of opportunity that have not yet really been explored?

Extensive investments in infrastructure in both developed and developing

countries are required to ensure climate change mitigation, and this is expected to result in increased deal flow, critical in a highly competitive investment market.

While climate change poses an unprecedented risk to the world, it also brings a wealth of opportunities. If one thinks about how energy or other technological transitions have occurred over history, the successful disruptions have been technologies that offered superior benefit-cost trade-offs for consumers. As investors, supporting the technological developments for a low-carbon economy transition is a very exciting and profitable prospect. ■

It bears underscoring that the opportunities that come from climate change will go well beyond renewables, and that is how we need to be thinking.

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Moving Past the Debate

The U.K. approach to resource and environment issues in actuarial work

BY KENNETH DONALDSON

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he Institute and Faculty of Actuaries (IFoA) in the United Kingdom established its Resource and Environment (R&E) Board in early 2014. I was fortunate enough to gain a seat on that founding board, and it has been a fascinating and occasionally challenging journey. I am not, by background, an R&E actuary; my training and experience is in U.K. pensions. Working in a highly specialized environment like pensions, you get used to being the expert in the room. I don't think many of the R&E Board members would

describe themselves as “experts” with deep domain knowledge in what is such a massive and rapidly developing area, but I believe as a board we have made great strides. I also believe it is an area where actuaries can contribute, since resource and environment issues are fundamentally issues of long-term risk management. Indeed I could make a strong case that R&E issues are, at their core, financial and economic issues that also affect mortality and morbidity experience in a complex, dynamic feedback system.

This article is a personal reflection touching on some of the key themes and issues with which the R&E Board is involved. But I think it is worth saying that the very creation of this board was a major statement by the IFoA. There had been an active Members' Interest Group (MIG) for some time, which had produced a number of thought-provoking papers and events on R&E topics. However, to elevate that MIG to full-blown "board" status signaled a real intention to lead on these issues.

While congratulating the IFoA on its leadership, my view is that this step can also be seen defensively. That is, it also flagged a determination that actuaries, in whatever sphere of the profession's activities, should not be behind the curve on such crucial and all-pervasive issues such as those posed by climate change, of potential planetary limits to (economic) growth and of the potential for profound change that could limit the value of historical analysis in predicting the future. We live in a fast-changing world.

Since 2014, a lot of water has passed under the bridge. Many events have been held, discussions taken place, papers written. I would like to highlight a few of these in this article. I stress this is my personal view as a member of the R&E Board since its inception, and I am not attempting to cover all of the various work-streams and efforts of the past four years.

The Risk Alert

I think a good place to start in discussing the work the R&E Board has done would be our "Risk Alert." This was issued to all IFoA members in May 2017. Risk Alerts are a series of emails from the IFoA, drawing attention to specific issues where the IFoA asks its members to think carefully about the consequences of the actions they take. The May 2017 alert states, "All actuaries should consider how climate change risks affect the advice they are providing."¹

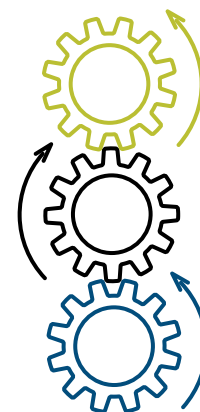
The alert draws on the framework developed by Mark Carney, governor

of the Bank of England, in his seminal speech of September 2015, titled "Breaking the Tragedy of the Horizon—Climate Change and Financial Stability."² This short speech, in my view, is a model of clarity and very much worth 15 minutes of any actuary's time to read. It decomposes the huge topic of climate risk into three separate buckets: physical, transition and liability risk. The first of these is the most obvious, representing the potential for damage caused by increasingly severe weather and rising sea levels. The second, transition risk, is a discussion of the potential to be on the wrong side of fast, severe and permanent movements in markets as the global economy shifts from a high-carbon to a low-carbon energy basis, and includes the risk of a disorderly transition. The third bucket is something we are already starting to see a lot more of: the threat of litigation for damages brought by those who are suffering the ill effects of climate change. As Governor Carney rightly predicted, the risk of litigation for loss and damage "will only increase as the science and evidence of climate change hardens."³

The Practical Guides

For the IFoA, warning all its members (regardless of their practice area) to consider climate risks in their advice is clearly a huge step. But it begs the question, "How?"

To help to address this, the R&E Board has embarked on the production of a series of practical guides. The first of these was a practical guide for pension actuaries. It contains not only the basic background material you might expect, but it goes on to look specifically at areas of work pertinent to pension actuaries such as the strength of the sponsoring employer's covenant, the setting of mortality assumptions and the pension fund's investment strategy, and it discusses the sorts of questions the advising actuary might start to raise with his or her clients. See the sidebar on page 50 for more details.



The huge topic of climate risk can be broken down into three separate buckets: physical, transition and liability risk.

RESOURCE AND ENVIRONMENT ISSUES: A PRACTICAL GUIDE FOR PENSION ACTUARIES

The Institute and Faculty of Actuaries (IFoA) Resource and Environment (R&E) Board has published a practical guide for pension actuaries on how to consider climate risks in their advice to clients. Here is an annotated extract from the guide:¹

- 1 | Learn more about R&E risks to be equipped to discuss them with clients. (A set of references and study material is provided separately.)
- 2 | Encourage trustees to raise R&E issues in discussions with their covenant adviser and the employer. (Again, a set of questions on this topic is provided separately.)
- 3 | Find out how your clients are addressing R&E risks in their investment processes and consider whether your funding advice is consistent with these risks.
- 4 | Review whether your models adequately incorporate R&E risks and whether the documentation is adequate.
- 5 | Use scenario analysis to explore uncertainty in financial and demographic factors arising from R&E issues.
- 6 | Help trustees adopt an integrated risk management approach that includes R&E risks.
- 7 | When giving advice, communicate your approach to R&E risks and the associated uncertainty.

Reference

¹ Hails, Robert, Jake Attfield, Evie Calcutt, Ruairi Campbell, Andrew Claringbold, Laura Duckering, Stuart Gray, Scott Harrison, Claire Jones, Stephan Le Roes, and Nick Spencer. 2017. "Resource and Environment Issues: A Practical Guide for Pension Actuaries." Institute and Faculty of Actuaries. July 18. <https://www.actuaries.org.uk/documents/practical-guide-pensions-actuaries>.

The guide does not pretend to be a step-by-step manual for incorporating climate risk, or resource- and environment-related risks more generally, into the day-to-day advice given by (in this case) pension actuaries. In reality, we are all at the beginning of a journey in this respect, and there is therefore no single right answer. On the contrary, although we don't know the right answer, our thesis is simply that we do know the wrong answer, and that is to ignore these risks and carry on regardless. We believe that would be a failure on many levels, not least of all the profession's public interest duty as set out in its charter.

We recently produced a more detailed follow-up paper that looks specifically at mortality and how resource and environment issues might affect U.K. mortality rates. The paper also drills into questions such as the effects of air quality and of temperature-related death rates. Similarly, a more detailed follow-up paper discussing sponsor covenant has been issued. A practical guide specifically for actuaries working in defined contribution (DC) pensions is forthcoming, and others focusing on practice areas such as general insurance and life insurance are planned. The target is to produce two to four guides per year. This is ambitious, particularly as we rely entirely on volunteers, but we intend to build a strong corpus of background information and assistance that distills these vast and complex topics so that actuaries can start to explicitly incorporate these fundamental risks into their work in a meaningful way.

The work of the IFoA R&E Board goes well beyond producing general guidance and material for actuaries in established practice areas such as life or pensions. We also spend significant time and effort thinking about and responding to specific questions and consultations. I would like to highlight one of these areas in particular, as I believe it has potentially far-reaching ramifications. This is the consultation and resulting recommendations of the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD). The recommendations, if implemented widely, have the potential to have an impact both directly and indirectly on the work of many, if not all, actuaries. The IFoA responded to the Task Force's consultation and strongly supports what have become known as the Bloomberg Recommendations, named after the Task Force's Chair, Michael Bloomberg.

The Bloomberg Recommendations: "What Gets Measured Better Gets Managed Better"

In the United Kingdom generally, the fact that there is a scientific basis for concern over the effects of climate



change is no longer an active debate. Rather, it is more common to get push-back on the question of what to do about this risk, and in some quarters, the view seems to be more or less that we should not worry overly about it. Technology will sort it all out, and omniscient, perfectly working, perfectly efficient markets will at all times ensure a smooth incorporation of the true price of this climate risk, such that market signals will automatically and seamlessly move us from the current paradigm into a low- or zero-carbon future.

Suffice it to say that this line of thought does not accord with good actuarial risk management practice. The Financial Stability Board (FSB) was so concerned about the possibility of severe financial shock that it established the TCFD. With one eye firmly on the crisis of 2008, the FSB



While existing laws throughout the G20 require corporate disclosure of material risks, when it comes to climate risk, at best this tends to be relegated to a sustainability report and confined to information about levels of greenhouse gas emissions.

worried that a lack of information about (climate) risks could lead to a mispricing of assets/misallocation of capital, and potentially give rise to concerns about global financial stability “since markets can be vulnerable to abrupt corrections.”

While existing laws throughout the G20 require corporate disclosure of material risks, when it comes to climate risk, at best this tends to be relegated to a sustainability report and confined to information about levels of greenhouse gas (GHG) emissions. Generally, such reporting never touches the all-important financial pages of the report and accounts.

Bloomberg’s task force was asked to design “disclosures that will help financial market participants understand their climate-related risks ... [that] ... could promote more informed investment, credit

and insurance underwriting decisions” and, in turn, “would enable stakeholders to understand better the concentrations of carbon-related assets in the financial sector and the financial system’s exposures to climate-related risks.”⁴

The resulting report is very detailed, but boils down to four recommendations for forward-looking disclosures about climate risk that should appear within an organization’s financial filings.

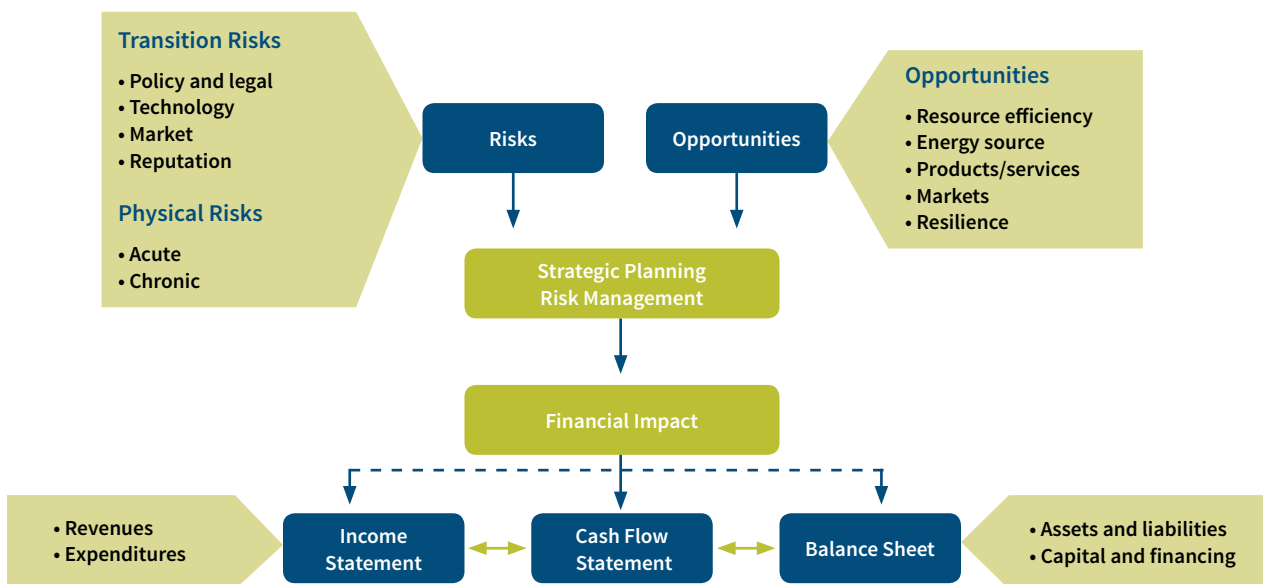
The recommendations are for voluntary adoption but, as of Dec. 12, 2017, 237 companies with a combined market capitalization of more than \$6.3 trillion have publicly committed to support the initiative. Naturally this includes a number of large insurance companies. However, I believe all actuarial practice areas will feel the impact. The recommendations specifically extend to asset owners as well, including public and private sector pension plans. The recommendations clearly speak

to the entire length of the investment chain, from issuance to credit rating, from stock exchanges to investment management.

For me, there are two key diagrams in the final set of recommendations that go a long way to summarize the issue (Figure 1) and the proposed approach (Figure 2).

Figure 1 deals with risk, opportunity and impact. Any actuary can immediately see this will apply directly at the corporate level for those working in general insurance. However, it also has pertinence in the life sector, via impacts on mortality (changing patterns of extremes of heat/cold, flooding and severe weather deaths, increased energy and food prices, disruptions to economic growth and consequential health care knock-on effects, changing disease-borne vectors, water and air quality issues, food security, etc.). But most obviously, it affects companies in the general economy, which means share prices and debt ratings. And I mean all

Figure 1 Climate-related Risks, Opportunities and Financial Impact



Source: Task Force on Climate-related Financial Disclosures. 2017. *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*. June. <https://www.fsb-tcf.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf>.

Figure 2 Recommendations and Supporting Recommended Disclosures

Governance	Strategy	Risk Management	Metrics and Targets
<p>Disclose the organization’s governance around climate-related risks and opportunities.</p>	<p>Disclose the actual and potential impacts of climate-related risks and opportunities on the organization’s businesses, strategy and financial planning where such information is material.</p>	<p>Disclose how the organization identifies, assesses and manages climate-related risks.</p>	<p>Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.</p>
<p>Recommended Disclosures</p>	<p>Recommended Disclosures</p>	<p>Recommended Disclosures</p>	<p>Recommended Disclosures</p>
<ol style="list-style-type: none"> 1. Describe the board’s oversight of climate-related risks and opportunities. 2. Describe management’s role in assessing and managing climate-related risks and opportunities. 	<ol style="list-style-type: none"> 1. Describe the climate-related risks and opportunities the organization has identified over the short, medium and long term. 2. Describe the impact of climate-related risks and opportunities on the organization’s businesses, strategy and financial planning. 3. Describe the resilience of the organization’s strategy, taking into consideration different climate-related scenarios, including a 2-degree Celsius or lower scenario. 	<ol style="list-style-type: none"> 1. Describe the organization’s processes for identifying and assessing climate-related risks. 2. Describe the organization’s processes for managing climate-related risks. 3. Describe how processes for identifying, assessing and managing climate-related risks are integrated into the organization’s overall risk management. 	<ol style="list-style-type: none"> 1. Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process. 2. Disclose Scope 1, Scope 2 and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks. 3. Describe the targets used by the organization to manage climate-related risk and opportunities and performance against targets.

Source: Task Force on Climate-related Financial Disclosures. 2017. *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*. June. <https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf>.

companies, not just the oil, coal and gas majors. Every company relies on energy and transport to get products to customers. Therefore, the same logic applies to pension and investment actuaries, too.

Figure 2 starts to unpack the recommendations. These FSB-endorsed recommendations, accepted by the G20, pertain to all actuaries since they directly apply to all insurance companies, investment managers and pension funds. In terms of reporting, it is true that some asset owners (pension funds) have no public reporting requirement, while others provide for extensive public reporting. For purposes of adopting the task force’s recommendations, asset owners should “use their existing channels of financial

reporting to their beneficiaries and others where relevant and feasible.”

Asset managers should also up their game, providing more detailed reporting, including “items such as the aggregate carbon intensity of the portfolio compared with a benchmark, the portfolio’s exposure to green revenue (and how this changes over time) or insight into portfolio positioning under different climate scenarios.”

It will take some time to fully digest the TCFD recommendations. However, the approach has been, from the start, an industry-led one, with task force members from across the G20 with different sectors represented, each with competing interests, different politics and legislative tensions. Yet it has come together very

quickly and reached consensus to deliver a coherent set of detailed proposals.

Key to this is the shift to financial disclosure. GHG emissions disclosure is all very good, but really the big question is what does it mean for P&L and the balance sheet? Thus the disclosure should now sit within the financial statements. This has implications for corporate risk/audit committees and for auditors themselves. Further, these disclosures will need to be forward looking, not just backward reporting. This is the hardest and most bold piece of the puzzle and will require the preparation and publication of detailed and coherent future scenarios of the financial

As of December 2017, 237 companies with a combined market capitalization of more than \$6.3 trillion have publicly committed to support the Bloomberg Recommendations. It is clear that some of the most powerful institutions in the world are very serious about the potential impacts of climate change.

implications for the reporting entity of the potential impacts of a “two degree economy.” That is, a world in which the current best estimates of the preconditions for keeping global warming to under 2 degrees Celsius are attained. A future economic scenario based on a complex dynamic system? Sound like an actuarial discipline? It does to me. I said earlier I would return to the subject of scenarios. I think that Bloomberg and the FSB are putting complex scenario generation at the heart of all financial disclosures. Actuaries have a chance therefore to put themselves in that same place, at the core of the analysis, no matter which type of actuary they are. The opportunity is immense, as will be the need, as there are no ready-made solutions out there.

The scope of the recommendations covers all listed companies, plus, as I have said, asset owners and managers throughout the G20, reaching some 80 percent of all global economic activity. It is very clear that some of the most powerful institutions in the world are becoming ever more serious about the potential impacts of climate change.

As I said at the outset of this article, in the United Kingdom and throughout Europe, the debate on climate change has moved on, and now the argument concerns the timing and the means by which targets will be met. I am aware that in the United States and Canada, the climate debate is far more politicized. But with the explicit endorsement of so many companies (including more than 150 financial firms, responsible for assets of more than \$81.7 trillion), it may well be that whether you happen to agree with it, this train is leaving the station and the agenda is being transformed. The IFoA is therefore making these Bloomberg Recommendations a key focus for raising awareness within our actuarial communities. ■

Statements of fact and opinions expressed herein are those of the individual author(s) and are not necessarily those of the Society of Actuaries or the respective authors' employers.

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LIVING to 100

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Please submit an abstract or outline of your proposed paper by Aug. 30, 2018. Abstracts should include a brief description of the topic, data sources and methods to be used, key items to be covered, and how your paper will contribute to current knowledge, theory and/or methodology. A brief curriculum vitae or resume is also required.

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Questions may be directed to Ronora Stryker, ASA, MAAA, SOA Research Actuary, at rstryker@soa.org.

Double Threat

The impact of climate change on human health

BY JESSE E. BELL



C

limate influences much of the world around us, and many aspects of climate are taken for granted. The seasons, crops growing, flowers blooming, insects emerging—these are just some examples of what climate controls.

The medical field has long understood that climate can regulate human health. Hippocrates, the ancient Greek physician who is one of the leading historical figures in medicine, documented abnormal changes in local weather in his reports describing disease outbreaks.¹ In 1814, James Tilton, M.D., then-surgeon general of the U.S. Army, required all military surgeons to record the daily temperature and precipitation records at military hospitals, because he understood that changes in weather were directly tied to the health of soldiers.² Those early weather observations

recorded by the army surgeons now comprise some of the first climate records for the United States.

In present-day medicine, there are both anecdotal stories and extensive scientific evidence describing the links between changes in climate and the occurrence of diseases, deaths, injuries and various other health outcomes. Thus, if our climate changes, we can expect that health outcomes will also change.

Climate Change and Health

In 2016, the White House released a report detailing the impacts of climate change on human health.³ One of the key findings of that report was that “climate change is a significant threat to the health of the American people.” This statement seems bold, considering all of the different health threats we face on a regular basis. You might start asking:

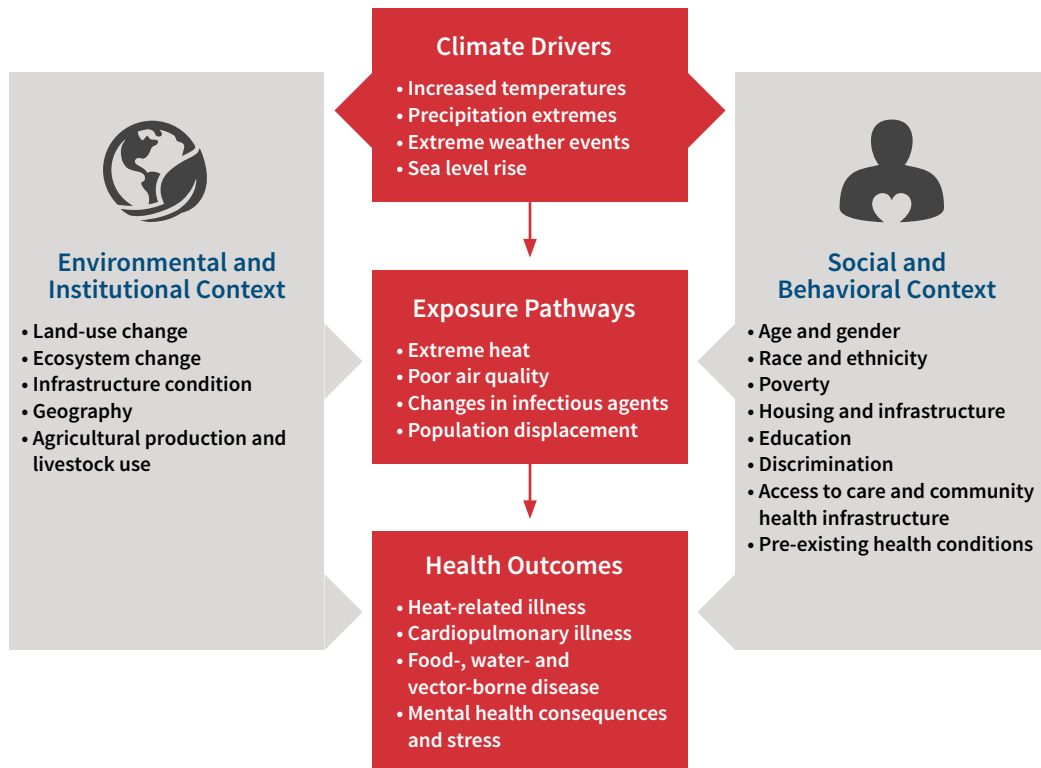
- » “How is climate change linked to my health?”
- » “Why would warmer temperatures bother me?”

The links between climate and health are not always apparent to the casual observer, but the connections are there. Changing one component in our climate, such as the global temperatures, can also cause other aspects of the environment around us to change (including increases in air pollution, changes in disease prevalence, exposure to deadly heat waves and numerous other effects; see Figure 1). Thus, we should expect that changing the thermostat of the Earth would have additional consequences on our health.

As many of us live in industrialized nations with limited exposure to the elements, we can typically minimize the effects of weather and climate on our daily lives. We do that by living indoors, wearing weather-appropriate clothing or limiting our time in conditions that we find uncomfortable. These minor adjustments do not mean that climate change will not affect our health—it simply means that those with the resources to adapt to climate change are less likely to experience as many negative outcomes as those with fewer resources.



Figure 1 Potential Link Between Climate and Health Outcomes



Source: Crimmins, Allison, John Balbus, Janet L. Gamble, Charles B. Beard, Jesse E. Bell, Daniel Dodgen, Rebecca J. Eisen, Neal Fann, Michelle D. Hawkins, Stephanie C. Herring, Lesley Jantarasami, David M. Mills, Shubhayu Saha, Marcus C. Sarofim, Juli Trtanj, and Lewis Ziska. 2016. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. Washington, D.C.: U.S. Global Change Research Program.

Changes in Extreme Events Lead to Health Outcomes

Changes in extreme events lead to some of the most easily seen and understood health impacts from climate change. In 2017, the United States experienced grim reminders of the human and economic costs of these extreme events, which included 16 disasters that in total exceeded \$300 billion in cost and resulted in more than 360 attributed deaths. Evidence consistently has shown that some extreme events (such as heat waves, droughts and flooding rains) are becoming more intense and frequent. (See “Observing Mother Nature” by Stephanie Herring on page 28 for more information.)

Each year, extreme weather and climate events are directly responsible for thousands of deaths and injuries around the world.

The natural line of reasoning would allow you to conclude that as these events get stronger, the potential ramifications will only become greater. Research is starting to explore this link, and early results have shown that more deaths are occurring as a result of some of these extreme events being more intense and frequent because of human-caused climate change.⁴ Because these increases in severity and frequency are projected to continue in the future, the corresponding number of deaths and injuries could also increase.⁵

Pathogens and Climate Change

The changes in climate that we have experienced during the last century—and will face in the coming century—change other aspects that influence our health. Climate

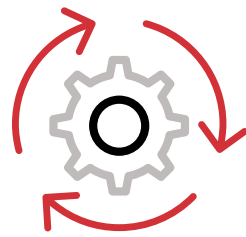
plays a critical role in biological activity. By this, I mean where and when things can live. As temperatures rise and precipitation patterns change, the climate begins to become more hospitable for some organisms and less favorable for others.

Over the past century, there are reports of disease-carrying mosquitoes moving north into new habitats as temperatures warm and precipitation patterns change. Studies also have shown a link between higher temperatures and the spread of the North American tick, *Ixodes scapularis*, that carries Lyme disease.⁶ As ocean temperatures have increased over the last century, *Vibrio* infections—from a pathogenic bacterium that lives in coastal waters—are now occurring at higher latitudes.⁷ The infections from this bacteria can come from eating contaminated oysters or from exposed wounds, with effects ranging from mild gastrointestinal illness to severe infections and even death. These are just a few of the many examples of climate change contributing to the spread of infectious diseases.

As climate continues to change, new disease threats may emerge. It is difficult to say exactly what will be next, because diseases are constantly evolving and developing. A few years ago, little attention was given to the Zika virus, an often overlooked disease spread by mosquitoes. This virus is now a major concern of many public health officials across the globe. Although it is difficult to determine what, if any, link there is between the recent outbreak of Zika virus to climate change, the future increases in temperature and changes in precipitation could help spread this disease and other similar ones.

Respiratory Illness and Climate Change

Other alterations to our environment from climate change can lead to serious health consequences. As carbon dioxide increases in the atmosphere and the growing season lengthens due to the resulting rise in temperature, some of the plant life around



As climate continues to change, new disease threats may emerge. It is difficult to say exactly what will be next, because diseases are constantly evolving and developing.

us is thriving and doing quite well. At first, this seems like a positive effect of climate change, which is partly true. However, as plants thrive, some release pollen in the air for reproduction. The more the plant thrives, the more pollen it produces. For those of us who suffer from allergies, this release of pollen can be very burdensome and can create unpleasant allergic reactions to going outside. For those 300 million people worldwide who suffer from asthma or other serious respiratory issues, pollen in the air can be a serious threat to life. Ragweed, a common plant that produces highly allergenic pollen, has experienced an increase in the length of its pollen season by 13 days to 27 days due to increases in temperature over the last couple of decades.⁸

The lengthening of the growing season and increased production of vegetation can have another consequence. Wildland fires have been starting earlier in the year and are lasting longer. This is partly due to the management practices that have suppressed wildland fires, which can cause them to erupt into very intense fires, but our changing climate is also to blame, as temperatures are increasing and droughts are becoming more common.⁹ Not only do these fires cause destruction of property and deaths associated with the fire, the smoke can travel hundreds of miles and cause respiratory ailments for anyone in the path.

Mental Health and Climate Change

For those who face the aftermath of a natural disaster, such as a hurricane, severe drought or wildfire, the health consequences may not always be apparent. Loss of loved ones, property, employment and displacement from homes can have long-lasting effects on individuals or communities that live through these events. People who experience these climate-related events can suffer from post-traumatic stress disorder, increased anxiety and depression, which can lead to long-term mental health issues.



Unfortunately, mass migration can lead to conflict and turmoil if residents of the host location are opposed or resistant to the influx of newcomers.

Climate change can also lead to the displacement or migration of people seeking to escape the environmental threats they previously faced. For example, this can happen when an extreme event forces individuals to suddenly move to new locations to escape the destruction of a storm. Gradual change can also cause the environment around a community to become inhospitable. Some island nations of the Pacific Ocean are already looking for new places to live as rising sea levels slowly make their islands uninhabitable. Not only are the oceans overtaking their lands, but the freshwater on their islands is no longer potable because of the salt water intrusion. People in these circumstances can lose their cultural identity as they try to adjust to new ways of life.

Conflict and Climate Change

As populations are forced to relocate, communities and systems of government will need to accommodate these people. These groups may temporarily occupy a new location, as with the mass migration of people seeking reprieve from the devastation of an extreme event, or they may relocate permanently, as with populations whose previous homes can no longer sustain their existence. Assisting these populations during and after their displacement can be costly, because they will need support and assistance to establish themselves in their new homes.

Unfortunately, mass migration can lead to conflict and turmoil if residents of the host location are opposed or resistant to the influx of newcomers. Combining two distinct groups of people can lead to conflict. Strife can also arise if a particular population is unable to adapt or deal with the environmental pressures faced because of climate change. Some debated evidence suggests that the conflict unfolding in Syria may have been sparked by climate change.¹⁰ The drought that preceded, and potentially contributed to, the Syrian conflict was shown to be intensified by climate change.

Although some debate exists on the relationship of this drought to the conflict that followed, the basic model of a severe climate-related event leading to something similar to the Syrian conflict easily can be imagined. First, a climate-related event causes a group of people to experience severe distress. If that group is then unable to find the resources needed to adequately sustain their livelihoods, they may become frustrated and hostile toward the systems of government or groups that they believe responsible for their difficulties. Depending on the manifestation of this situation with the various parties involved, fighting and conflict can be one of the potential outcomes. However, a number of other factors are needed to cause this chain of events to unfold, but the potential for climate change to cause or exacerbate civil unrest is possible given certain conditions.

How Will Populations Cope?

Are all populations vulnerable to the health impacts associated with climate change? Yes. However, some populations are more vulnerable to climate change than others. People who typically are more vulnerable are the very old, the very young, those with fewer financial or societal resources, workers in certain occupations and individuals with preexisting medical conditions. (See “The Vulnerable” by Sam Gutterman on page 34 for more information.)

Because of the number of people who are vulnerable to these threats, public health agencies throughout the world are starting to take notice of climate change as a health threat. Officials who work for these agencies are creating plans that will help communities prepare for the health effects associated with climate change. Empowered with the best scientific information available, local communities can reduce the risks associated with changes in diseases, injuries and deaths that will come from climate change. Some of these health agencies are accomplishing this work with external funds, but many institutions are devising plans without much support. This work has an added benefit for these communities, as the plans created by public health agencies to address climate change also prepares communities for many other potential disasters and associated risks.

The goal of this article is to illustrate that climate change poses a threat to our health, and to bring awareness to these issues. Although many topics discussed here are concerning, there is still an opportunity for our communities to address these health issues caused by climate change before they become more problematic.

- 1 | We can invest in clean technologies, such as renewable energy sources and energy efficient products, that reduce the production of greenhouse gases that cause anthropogenic climate change.
- 2 | We can improve existing infrastructure or create new infrastructure to reduce the potential consequences of climate change. Improvements of infrastructure near coastal regions are especially important, as these areas are generally more susceptible to the effects of climate change than other regions, with the continued rising of sea levels along with more frequent flooding and increasing population density.
- 3 | We can work across sectors and institutions to understand potential threats and develop new strategies to combat these issues. Public health agencies should not be the only institutions trying to address the negative health outcomes associated with climate change. Mitigation and preparation can start with a variety of private

and public institutions, including hospitals, health care providers, sanitation services and utility companies.

- 4 | We can expand our research efforts to identify the future health risks associated with climate change in order to take a more proactive approach to health care. Because climate change is already occurring, research could help determine the current excess burden and costs on health care.

By working to address the issues identified in this article, communities have an opportunity to reduce their vulnerability to the health impacts of climate change while improving public health, safety and well-being, and reducing potential costs at the same time. ■

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An International Career

**Q&A with
Tatcha Ayana,
FSA, CERA,
P&C actuary**

What about being an actuary interests you the most?

I've always been a little bit of a nomad and a geek for all things technical. This career is a perfect fit because qualified actuaries are still in demand in many parts of the world.

It's very humbling to go through a period of feeling useless after moving to a new country and experiencing a new culture. And yet, everywhere I go I find it comforting that our profession is held to a high standard. In a way this helps me gain acceptance from my colleagues. Also, the fact that our community is so well stocked with resources means I can always find an expert or an article on the internet.

I've worked in the United States, Germany, Japan and Thailand. I'm still wondering where to go next.

How did it feel to be the first actuary your company ever hired?

I felt a lot of trepidation at first. I had little property and casualty (P&C) business intuition because my background is in life and health. And even if I knew all the theories in the world, I wouldn't know how to put a model together in a useful way.

So I took some P&C underwriting exams before I came on board to at least understand the lingo of the P&C business. Even more of a challenge: My company had a domestic shareholder so the culture was very local. Having spent all my life


with international companies, I had to be very sensitive to the way things were run.

Then I came on board. Below me, I had a team of tech-savvy actuarial students. Above me, I had a supervisor and regional actuaries who were all very seasoned and wonderful coaches. Our first task together was to figure out where the company needed an actuarial touch—and that was building a database for pricing and figuring out how much reserve my company should hold on a best-estimate basis. Although this might sound trivial to my peers in developed markets, many Thai companies still don't have these things so it was hard to compare notes.

Things got easier a few years later, but I still think there is enormous room for me and my department to evolve.

How is the P&C area in your market evolving?

I have spent most of my time in personal lines, and I believe the Thai market is much simpler than the markets in the United States or Canada. The distribution channel is still mostly traditional; however, FinTech and InsurTech are catching up fast. Insurance penetration is still low given the lack of insurance literacy and low income level. If we want to survive, we need to be able to distribute products more cheaply and find effective ways to educate our customers.



No budget? Use open source software. No human resource? Let's quickly modernize our processes to cope with the workload.

Can you describe how predictive analytics is playing a role in the job you do every day?

At first, I was very textbook. I had my team use predictive analytics for ratemaking, but then we were stuck. So we enlisted the help of our regional data scientists to explore other clever methods outside of classical actuarial science. Over time we have expanded predictive analytics into areas like fraud detection and location-based analytics for customer profiling.

The predictive modelers with whom I've worked are super savvy at building tools at a minimum cost. Then there's the unsexy job of data cleaning, but these guys know how to do it fast. I'm thrilled that my team enjoys it too.

Personally, I enjoy the theoretical side so I would give guidance on what model to use and how to validate it.

How are you helping your company become more data-driven?

This transformation is still a work in progress. The first step is to make numbers available. The second step is changing the way people think.

As for the first part, my company came from the world where IT would routinely produce reports that users did not use. So the MIS team and I spent time revising reports to make data easy to digest. Now we are upgrading tools and dashboards to make analysis more dynamic.

Regarding the way of thinking, it was common for my colleagues to throw out qualitative information, like, "Our company's premium is too high." Then I'd ask back, "Where did you obtain this information?" to get my colleagues to be specific. Ensuring that we are more fact-based instead of feeling-based really helps my management to work more easily.

What is the most fun aspect of your job?

For one, I love detective work. I love taking things apart and seeing how stuff works.

For another, being in a small shop with numerous constraints allows creativity to blossom. No budget? Use open source software. No human resource? Let's quickly modernize our processes to cope with the workload so we can move on to do cooler projects.

How do you foster team spirit and good communication?

Definitely by listening a lot. Especially with respect to my current situation—as we are in the middle of transforming our business, it's very easy for people to become impatient and critical with each other. I always take the time to establish rapport with my colleagues, and then spend even

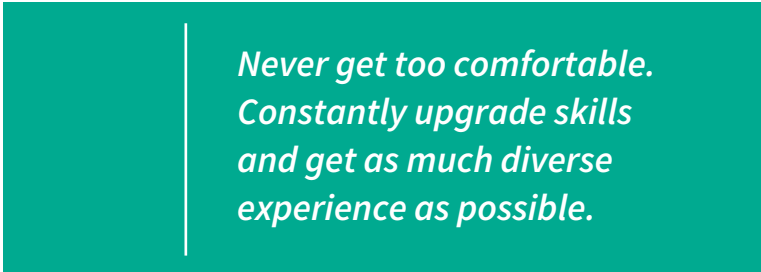
more time to gather the full backstory before offering my own opinion.

I feel that we have made very good progress to become less "backroom," but now I think we have to work even harder to understand the language outside our domain.

What has been the most exciting role you have worked in during your career and why?

This one. Dropping everything I know about life insurance to join a small P&C company was nerve-racking—amidst the intense pressure of getting everything right. This leads to spending many weekends figuring out how theories work, learning how to code in R and getting my hands dirty in cleaning data. Otherwise I would not be able to command respect from my team and colleagues. This is also when I most relish having a good support network. I found myself reaching out to my P&C colleagues from my former companies.

I am a compulsive information gatherer who wants to catch up with my colleagues and the science very fast. I have taken the Society of Actuaries' (SOA's) online courses as well as courses on Coursera and EdX.



How do you measure success?

First, to be on the same wavelength as my colleagues is a small victory. Then, to empower my colleagues to do something good for the organization on their own initiative—especially in my culture where it is not common for people to speak up—is a bigger victory. Last, as a manager, if my junior team members know at least 80 percent of what I do, then I consider my job done.

How has your background as an actuary positively affected the work you do in your current position?

I have always enjoyed learning, and I have actuarial exams to thank for that. It's not that I learned most of the technical content from actuarial exams, but I had my fair share of fails despite having time off to study. I analyzed my studying style to see what went wrong, and then I kept at it until I became qualified. My working life is also very much

like that—failures, subsequent postmortems and hard work lead to resilience.

On the business side, my background in consultancy has taught me to look at the big picture before forging ahead to find solutions without understanding all of the facts. Also, my exposure to colleagues in different cultures and disciplines has allowed me to see things from different points of view.

What is your best advice for rising above the competition?

Never get too comfortable. Constantly upgrade skills and get as much diverse experience as possible.

I am a believer that over-specializing will result in me not getting hired to do anything outside my area. It might be good for some specific niches, but risky if my area is replaceable by a cheaper labor force or machines.

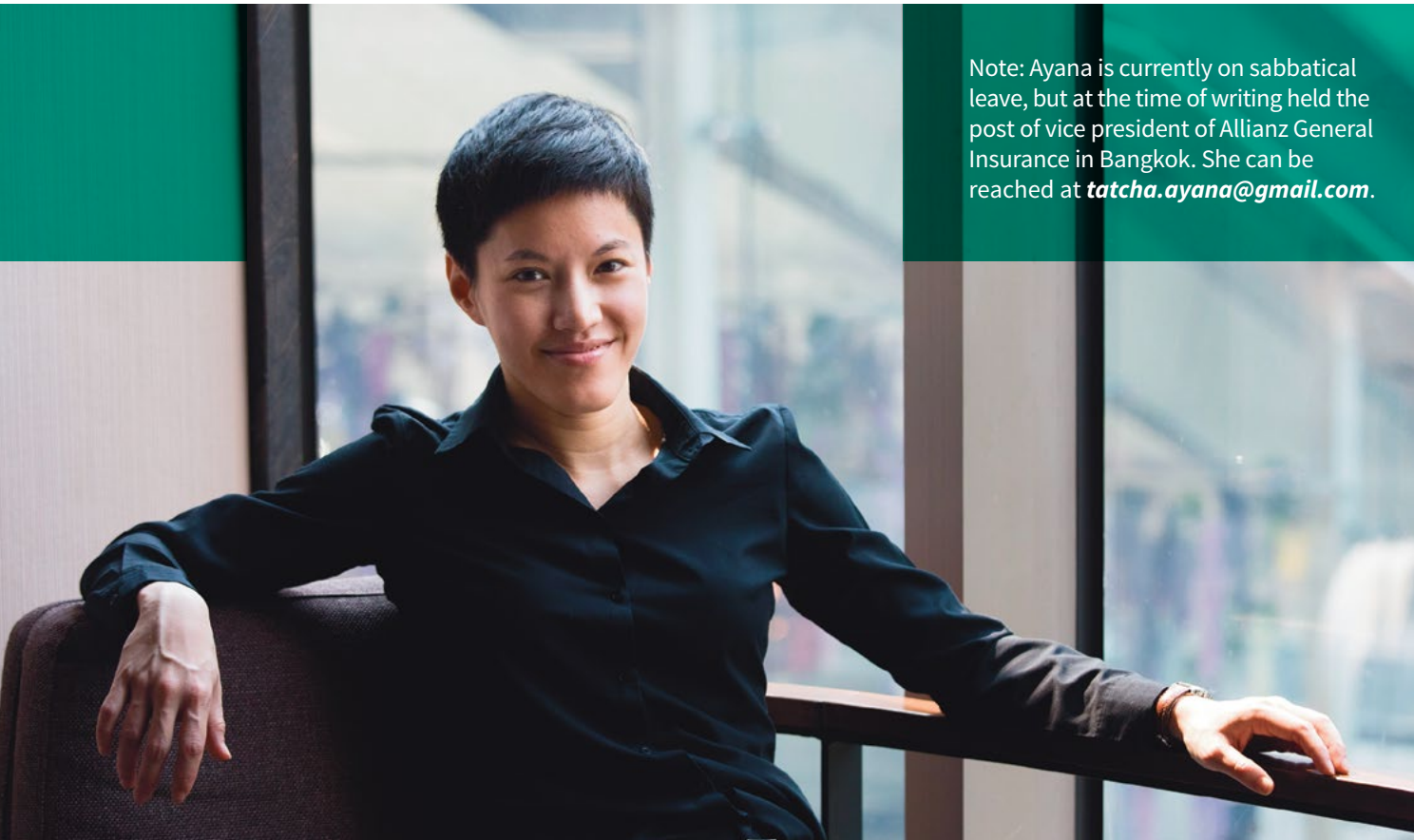
I think having a solid second skill really helps one rise above the competition. Recently, I have been working with data scientists, who are so good that I felt compelled to polish up my statistics and take programming more seriously.

I would not overlook nonacademic interests either. I have found that some of my colleagues’ hobbies have helped them to be more resilient, creative and interesting as individuals.

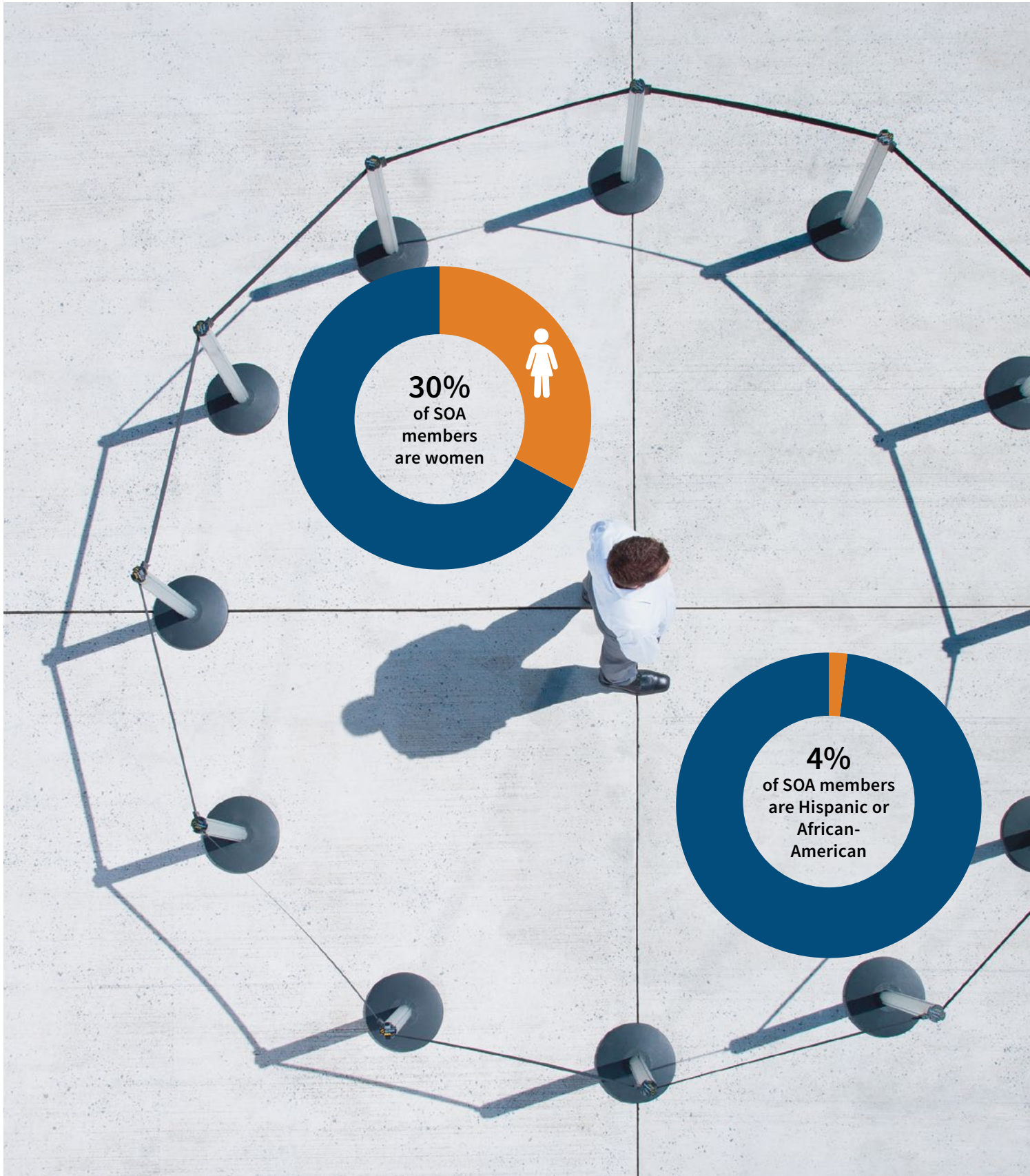
How do you see the role of the actuary changing in the future with regard to P&C, or in general?

P&C will definitely be more technology driven. People talk about data scientists sitting in the same space as actuaries: Is this a threat to the profession? Perhaps. You may have started seeing jobs replaced by robots. Maybe in the future it would be nice to have our work tech-reviewed by artificial intelligence (AI). Then we could move on to discovering new things and expanding our frontier.

Actuaries have an aptitude for all things technical. We have an aptitude to learn quickly enough to speak intelligently about a topic—be it business, mathematics or technology. Changes in regulation are hard to predict, but what won’t change is how fast our customers want things, so we have to move fast. ■



Note: Ayana is currently on sabbatical leave, but at the time of writing held the post of vice president of Allianz General Insurance in Bangkok. She can be reached at tatcha.ayana@gmail.com.



A Multipronged Approach to Removing Barriers

BY CRAIG W. REYNOLDS

Over the past two decades, the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS) have worked together to increase the number of women and racial and ethnic minorities working in the actuarial field. Women make up approximately 30 percent of the SOA membership. The 2017 class of new fellows is approximately 33 percent female. Though work remains to be done, progress is being made on the gender front. Unfortunately, the same cannot be said for progress on racial and ethnic diversity.

In 2018, Hispanics and African-Americans continue to be woefully underrepresented in the actuarial profession. Recent estimates from the U.S. Census Bureau put the representation of each group at just 2 percent.

An in-depth report released in fall 2017 titled “Diversity and Inclusion Research Initiative” uncovered many of the reasons racial and ethnic diversity remains so low. Conducted by C+R Research on behalf of the SOA, the CAS, the Actuarial Foundation and the International Association of Black Actuaries (IABA), the study revealed barriers at each point along the career pipeline that disproportionately impede minorities’ entry into the profession.

These obstacles include low awareness of the field and a lack of mentors and role models who can demonstrate that “actuary” is a viable career option for minority students, and insufficient financial support for both education and examinations (see the sidebar on page 69).

The SOA takes these findings seriously and is working hard to ameliorate these obstacles. Taking a multipronged approach, we believe we have the power to change the culture and increase opportunities for minority students and candidates across the country.

Starting at Home: Internal Actions

In June 2016, the SOA published a diversity statement on its website to clarify its goals for diversity and inclusion. It reads, in part:

The Society of Actuaries (SOA) best fulfills its mission when it is diverse and inclusive of all individuals. Openness to and acceptance of diverse perspectives, cultures and backgrounds helps to attract the best talent and ensures the overall inclusivity of the actuarial profession.

This statement, together with the efforts of our Inclusion and Diversity Committee, demonstrates our commitment

to increasing awareness, diversity and community.

That commitment is further evident through the information we publish and the influential speakers we host. Articles on diversity, mentorship and career development appear regularly in the Management and Professional Development Section newsletter and across our publications. The Actuarial Teaching Conference and the Actuarial Research Conference consistently include diversity-related sessions, and the Annual Women's Leadership Forum has been a mainstay at health meetings since 2015.

Through *Candidate Connect*, we take our goals for increased awareness and diversity directly to the students. This important newsletter helps to break down barriers by providing information and resources to students and candidates regarding exam preparation, networking opportunities, employment and changes in the field.

Finally, to help us track our progress in increasing diversity, we gather essential demographic data about our membership. When minority candidates see they are not alone, they will feel more welcome in our profession. If you have not yet volunteered your demographic data in your SOA profile, please do so now, confidentially, at bit.ly/SOADemographics.

Partnership, Sponsorship and Support

For the four organizations involved, publication of the "Diversity and Inclusion Research Initiative" was a proud achievement. This report was three years in the making and represented a true collaboration, with all parties contributing essential resources. The research has shed light on a problem we have known about anecdotally for years. At last, we have the data to help us move forward.

And we are off to a good start. In 2017, the SOA supported the grassroots creation of the Organization of Latino Actuaries (OLA). We intend to provide the same support to OLA in the coming years that

With these types of initiatives fully funded and supported, we can mitigate the obstacles that impede the progress of African-American, Hispanic and other minority students in achieving their goal of becoming actuaries.

we have provided to IABA and other organizations focused on diversity. Our missions are deeply connected and our continued coordination will have a positive effect for our members and the profession.

Another joint effort, the LGBT and Allies resource group powered by the SOA and the CAS, will launch in 2018. This group will further engage a diverse population and welcome them to the actuarial profession.

However, the centerpiece of the SOA partnerships for diversity is the Joint CAS/SOA Committee on Career Encouragement and Actuarial Diversity (JCCEAD). This committee strives to increase awareness of the actuarial field among high school, college and university students, educators and others. These efforts reach students as well as influencers who can act as mentors and guide students who wish to become actuaries.

The JCCEAD sponsors several programs specifically designed to remove barriers:

- » **Conferences.** The National Council of Teachers of Mathematics, Joint Math Meeting, American Indians in Science and Engineering, Out in STEM, Advancing Chicanos/Hispanics and Native Americans in Science each provides support and education for a diverse group of potential actuarial candidates.
- » **IABA Actuarial Boot Camp.** This four-day workshop provides real-world actuarial experience along with interviewing

In 2017, the SOA supported the grassroots creation of the Organization of Latino Actuaries.



and other soft skills needed to land an internship, with a focus on black actuaries.

The JCCEAD-maintained website, *BeAnActuary.org*, serves as a resource for candidates who want to learn more about the profession. Some of the resources found on the website include:

- » Information on exam fee reimbursement for minority candidates
- » Links to organizations serving Hispanics, African-Americans, Native Americans and other groups
- » Information on scholarships for minority students and candidates sponsored by actuarial organizations and companies
- » Links to summer internship programs for high school students

The website also has a companion Spanish-language microsite. While English or French proficiency would be necessary to pass SOA examinations, research shows that families have a huge influence on attracting candidates to the profession, so the Spanish website may be a key tool in reaching Latino students.

Math Motivators is yet another influential program that the SOA sponsors. Created by The Actuarial Foundation, Math Motivators is designed to “help close the achievement gap by establishing a volunteer-driven math tutoring program that pairs low-income high school students with professional actuaries and college students majoring in actuarial science, mathematics or math education.”

The decision to support these efforts was an easy one to make. With these types of initiatives fully funded and supported, we can mitigate the obstacles that impede the progress of African-American, Hispanic and other minority students in achieving their goal of becoming actuaries. We can change the culture and create a more diverse and inclusive workplace.

If you attended the SOA Annual Meeting & Exhibit in 2017, you may have seen a keynote presentation by Scott Page.

In his presentation and in his book, *The Diversity Bonus*, Page shows how diverse teams are more effective at solving problems that require creative solutions. Bringing diversity to the actuarial profession can thus make us all more effective. Everyone wins. ■

ABOUT THE WRITER

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THE FIVE BARRIERS

Each stage of the career pipeline presents a new potential barrier for entry into the actuarial field. While all students face these hurdles to some extent, the effects are greater and more persistent for minority populations.

- 1 | **Awareness of the field.** Just 12 percent of surveyed African-American and Hispanic college freshmen had heard of the actuarial profession. In contrast, 25 percent of college freshmen from other backgrounds had heard of this profession. Lack of awareness has been shown to be the barrier with the farthest-reaching effects.
- 2 | **Consideration of actuary as a viable profession.** Because of the low representation of minorities within the field, many African-Americans and Hispanics do not see “actuary” as a profession that’s right for them. The time and money required to take and pass exams also make some candidates feel being an actuary is not a viable option.
- 3 | **Preference over other STEM professions.** The image of an actuary may not be as attractive as medicine, computer science or another STEM field. “Drawing minority students into the profession requires positioning the career as meaningful, attainable, rewarding, prestigious and secure,” the researchers report.
- 4 | **Intent to take and pass the exams.** The actuarial credentialing process requires time to prepare and take the exams, and money to pay for taking (and retaking) exams. In the survey, more than 50 percent of lapsed minority candidates indicated financial support for exam fees was insufficient to meet their needs, compared to 22 percent of other lapsed candidates. Furthermore, 31 percent cited the cost of exams as a reason they stopped pursuing a career as an actuary, compared to just 7 percent of other lapsed candidates.
- 5 | **Employment and retention.** Three factors—screening and stereotyping of resumes based on names and schools, subconscious racism and a lack of diversity in the workplace—combine to create an office environment that is unwelcoming to minority candidates.

New SOA University Programs to Benefit Students

BY GENA LONG AND TIFFANY TATSUMI

Ramen noodles, laundromats and dormitories. There are some memories of university life that seem to stand the test of time. While there are certain aspects of the college experience that more or less transcend generations, universities are ever-evolving. In recent years, more and more university actuarial science programs have been identified, with an increased interest from students to enter into the actuarial profession.

In the early 2000s, the Society of Actuaries (SOA) had just a few university-related programs—a list of colleges on the website, some financial support for faculty and a Ph.D. stipend award. But a little more than 10 years ago the SOA Board of Directors took steps to build better connections with academia through three key initiatives: a new University Outreach program, the creation of the Centers of Actuarial Excellence (CAE) program and the financial enhancement of the Ph.D. stipend award now referred to as the Hickman Scholars program. At the end of 2017, the SOA had visited 148 universities and colleges in 11 countries through the University Outreach program. The group of CAE-recognized universities has grown to 31; and the Hickman Scholar program has graduated 17 Ph.D. candidates, many of whom now hold positions at North American universities.

In 2015, the SOA launched the Actuarial Teaching Conference (ATC) for actuarial educators. The ATC is held every other year and provides an opportunity for all faculty members engaged in actuarial teaching to come together, participate in learning sessions, share ideas, network with each other, and learn more about the SOA and the actuarial profession. Two ATCs have now been

held, and educators have expressed their appreciation for the events. It was at the first ATC that the idea for an online Faculty Community was first discussed.

Oh, and that old college listing on the website? It was revamped in early 2015 to provide a better resource for students looking for a university/college actuarial program, and was renamed the Universities and Colleges with Actuarial Programs (UCAP) list. The change meant that each applicant for the list would be vetted to ensure they had resources dedicated to students studying actuarial science. The UCAP list included actuarial programs that maintained course coverage for at least two actuarial exams and had approved courses for at least one Validation by Educational Experience (VEE) topic. UCAP and CAE universities are also displayed on SOA Explorer, an interactive tool that uses Google Maps to not only locate universities, but SOA members, employers, clubs and more.

The response from the academic community to the growing number of SOA programs aimed at supporting universities with actuarial programs and their students has been extremely positive, and the SOA benefits from university programs that promote the kind of education needed for actuaries in today's world. As a result,

The SOA has visited 148 universities and colleges in 11 countries through the University Outreach program.



MENTORING OPPORTUNITIES

A 2015 survey of university faculty concluded that creating and building industry partnerships is a key challenge for actuarial programs. To help fill this gap, the SOA wanted to provide a way for university students to have direct access to actuaries, so it created the University Support Actuary program in 2017. The program links credentialed actuaries with local university actuarial programs to assist in advising students about the profession. It is anticipated that the program will eventually be available to all interested UCAP-AC and UCAP-IC universities.

Each volunteer actuary first participates in a training call with SOA staff and is provided with a toolkit designed to support a university connection. The newly trained volunteers are then asked to reach out to their assigned school to discuss any needs of the program and determine how best to provide support. As a point of first contact with students, a volunteer will typically arrange to make an SOA-prepared presentation to students on the actuarial profession and the SOA's educational pathways. Depending on the needs of the program and the volunteer's experience level, the volunteer may also assist with reviewing the program's courses and activities and providing suggestions, helping to arrange for speakers, providing insights on employer needs and mentoring students with regard to internship and employment questions.



the SOA continues to look for opportunities to enhance current university programs and add support where a need is seen.

In 2017, the SOA launched new university-focused programs that are aimed at supporting actuarial students as they seek to take exams and learn more about the profession. The organization is pleased to be able to provide financial support by way of reimbursements to students and direct access to actuarial mentors through new SOA programs.

University Recognition Tiers and Reimbursements

As a first step toward delivering these new student benefits, the SOA created new recognition tiers for universities. In addition to recognizing the CAE program that has been in existence since 2009, the UCAP list now includes two tiers of recognition to identify those programs with more substantial coverage of the SOA exams and requirements. This new structure allows the SOA to better direct university-related resources as appropriate. The SOA Explorer map now distinguishes universities by these recognition tiers. ■

ABOUT THE WRITERS

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UNIVERSITY RECOGNITION TIERS

The three university recognition tiers and their eligibility requirements are:

- » **Centers of Actuarial Excellence (CAE).** CAE have attained the highest level of recognition the SOA offers universities. They must maintain eight specific requirements related to degree, curriculum, graduate count, faculty composition, graduate quality, appropriate academic integration, connection to industry and research/scholarship.
- » **UCAP–Advanced Curriculum (UCAP-AC).** Universities must maintain course coverage for at least four SOA preliminary exams with one of those being Exam MLC or Exam C, and approved courses for all Validation by Educational Experience (VEE) topic areas. Effective July 1, 2018, the exams covered must include the Long-term Actuarial Mathematics Exam or the Short-term Actuarial Mathematics Exam.
- » **UCAP–Introductory Curriculum (UCAP-IC).** Universities must maintain course coverage for at least two SOA preliminary exams and have approved courses for at least one VEE topic area.

Universities were notified of their recognition status and the new reimbursement programs available for their students in mid-2017. The programs allow universities to apply for the specific SOA programs that suit their needs for a given year.

Available each academic year to universities at the CAE and UCAP-AC level:

- » Reimbursement of fees for three individual student SOA preliminary exam registrations (Exams MFE, MLC and C are eligible¹)

Choice of one of these options each academic year:

- » Reimbursement for the purchase of study materials for SOA preliminary exams up to US\$500
- » SOA sponsorship for an approved on-campus event up to US\$500
- » Reimbursement of travel costs and/or registration fees for student travel to an approved actuarial conference up to US\$500

Reference

¹ Effective July 1, 2018, the new Statistics for Risk Modeling Exam will be eligible for reimbursement along with the Investment and Financial Markets Exam and the Long- and Short-term Actuarial Mathematics Exams.

Students + Tutors + Donations =



Math Motivators

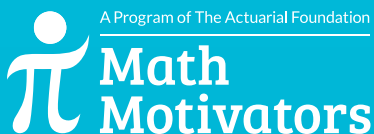
The Actuarial Foundation's Math Motivators tutoring program is working to close the achievement gap by pairing low-income high school students with professional actuaries and college students to help improve their math skills.

It's a win/win for actuaries and these students: tutors improve their communication skills while students are introduced to the actuarial profession and show improvement and increased confidence in their math abilities.

Double the impact of your donation to The Actuarial Foundation and help the Math Motivators program expand to more schools and communities across the country. **The Society of Actuaries** is generously matching its members' donations to the program up to US\$62,500 from **April 1-Sept. 1**.

Without your support, it doesn't add up.

SPONSORED BY



Donate today at mathmotivators.org.



Strategic Research Programs

Q&A with Sara W. Goldberg and R. Dale Hall

In support of the Society of Actuaries (SOA) 2017–2021 Strategic Plan, the organization developed the Strategic Research Program Initiative to determine key themes of strategic research for the future. Sara W. Goldberg, FSA, MAAA, chair of the initiative’s task force, and R. Dale Hall, FSA, CERA, MAAA, SOA managing director of Research, share details about this new endeavor.

How did the Strategic Research Program Initiative come about?

Goldberg: In 2017, the SOA established a task force on this Strategic Research Program Initiative to help lead this process. Both Dale and I worked on this task force, which consisted of a group of SOA members completing a comprehensive review of potential research themes. We looked at research program themes to focus on for the next three to five years. The task force focused on research areas that emphasize actuaries’ skill sets and thought leadership on important societal issues. These programs are intended to bring together existing projects, resources and materials, and combine them with new research studies and papers to be developed over the next few years. The task force presented its recommendations to the SOA Board of Directors on the key research themes. During the SOA Board’s 2017 October meeting, the Board approved five strategic research programs as part of this initiative.

What are the key themes identified?

Hall: The five Strategic Research Programs are on aging and retirement, actuarial innovation and technology, mortality and longevity, health care cost trends, and catastrophe and climate. These programs purposely cover a variety of practice areas, international applicability, research methods and key audiences for the SOA.

What is the focus of each of the programs?

Goldberg: There’s a lot of planning to do as we form research steering committees for each program. But we already know the core focus areas and related subject matter to cover in our research efforts. The first two programs are on retirement and innovation.

The Aging and Retirement Research Program will look at the societal and financial impact of aging populations. That means examining the different solutions to help mitigate the various retirement risks. This research will provide insights on individual risks faced in retirement, and topics include retirement planning decisions and retirement income, pensions and retirement systems, and long-term care insurance. We also want to examine the implications of the population living to older ages on average.

For the Actuarial Innovation and Technology Research Program, we will explore the impact of new technologies on actuarial work and on traditional employers of actuaries. It will include studying accelerated underwriting, machine learning, telematics and other innovations relevant to the actuarial field and the insurance industry.

Hall: The other three projects (to be worked on in 2019 and 2020) will cover mortality, health care and climate topics.

The Mortality and Longevity Research Program will involve the development of experience studies and the analyses of mortality and longevity trends. We’ll also examine factors affecting models and mortality predictions, so we plan on studying mortality improvement, population mortality and the socioeconomic drivers of longevity.



Get an overview of the SOA Strategic Research Programs and download the infographic on the key themes at [SOA.org/strategic-research/default](https://www.soa.org/strategic-research/default).



The Health Care Cost Trends Research Program will focus on health care utilization and cost drivers, including demographics, social factors and both medical and pharmaceutical utilization. It is important to learn more about public health and population health, along with health intervention and preventive medicine.

The Catastrophe and Climate Research Program aims to better understand climate trends and the impact of extreme events. That means more research on the shifting climate patterns, the impact on mortality and health from climate events, the use of public insurance and disaster response efforts.

Q: What are the next steps?

Goldberg: We're working on the Aging and Retirement Research Program. The current steps include the development of a steering committee, which will help refine the types of research projects for the program. The group will also form a landing page that will include our existing body of research on the topic. By the end of this year, we will start work on the Actuarial Innovation and Technology Research Program. Stay tuned for more details on the development and progress of these programs. Visit the strategic research page for updates and to find volunteer opportunities to participate. ■

Visit [SOA.org/Research](https://www.soa.org/Research) for the latest updates on new research opportunities, data requests, experience studies and completed research projects.

ABOUT THE WRITERS

SARA W. GOLDBERG, FSA, MAAA, is chair of the SOA Strategic Research Program Initiative Task Force. She can be reached at sara.goldberg@genre.com.

R. DALE HALL, FSA, CERA, MAAA, is SOA managing director of Research. He can be reached at dhall@soa.org.

RESEARCH READS

Actuarial Review of Insurer Insolvencies

The Society of Actuaries (SOA), Canadian Institute of Actuaries (CIA) and Casualty Actuarial Society (CAS) jointly released research on the causes of insolvency and decisions made by management, regulators and policyholders over the life cycle of the insolvency. It looks at historical insurer impairments and insolvencies and possible future prevention indicators.

bit.ly/InsurerInsolvencies

Health Provider Networks and Exchanges

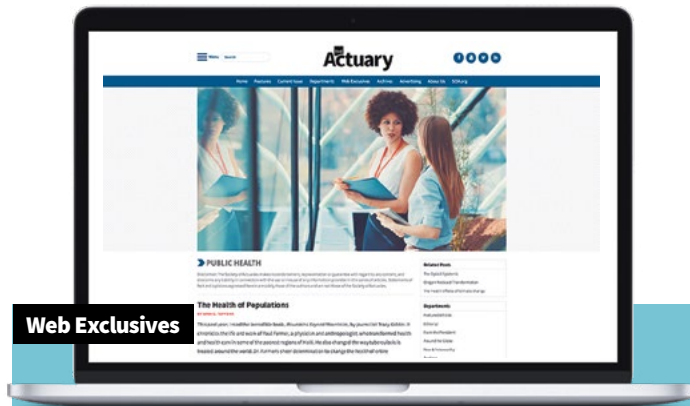
A report from the Health Section Research Committee looks at health provider network performance with a focus on experiences with health exchanges.

bit.ly/ProviderNetworkPerformance

Multiemployer Pension Plan Research

The SOA released reports on metrics for measuring U.S. multiemployer pension plans on contributions paid down unfunded liabilities and on the impact of employer withdrawals.

bit.ly/ContributionsPaidDown
bit.ly/EmployerWithdrawals



Web Exclusives

A Closer Look at the State of Our Health

Public health—it's a broad topic. From conducting scientific research, educating the masses, setting safety standards and developing school nutrition programs, public health includes all of us. The web-exclusive series on public health published on *TheActuaryMagazine.org* includes a wide array of articles on topics ranging from some of the early successes of public health such as vaccinations and family planning, to current headline issues such as suicide and opioids, to cutting-edge opportunities like community care organizations. Read the articles and see how you can contribute to the broad public health discussion to improve the overall health of society.

TheActuaryMagazine.org/category/web-exclusives/public-health

Understanding Barriers to Diversity and Inclusion

In a new study conducted on behalf of the Society of Actuaries (SOA), The Actuarial Foundation, the Casualty Actuarial Society (CAS) and the International Association of Black Actuaries (IABA), respondents were asked to consider the statement "The actuarial profession is not as diverse as it should be."

Read the web-exclusive article and download a copy of the barriers to entry research report to learn more. Find more information on the SOA's diversity and inclusion programs.

bit.ly/TheActuaryDiversityReport

bit.ly/DiversityResearchSummary

bit.ly/SOADiversity

NAVIGATI

Webcasts

Take Your Pick: Webcast Recordings Available

Looking to increase your knowledge base? You've come to the right place. Twelve professional interest sections have added several webcast recordings to their menu of educational offerings. Topics cover reinsurance, leadership, ethics, technology and more.

Section members can view these webcasts at no charge. There are just two simple rules:

- 1 | Webcasts must be at least one year old.
- 2 | You must be a member of a section that created the webcast to view at no charge.

Free webcast recordings are housed on SOA Engage and will require you to log in using your SOA username and password. Webcasts that have not reached the one-year mark can be purchased for \$144 through the SOA.

Engage.SOA.org

bit.ly/SOARecordings

Meeting

2018 SOA Health Meeting

Attend the 2018 SOA Health Meeting June 25–27 in Austin, Texas, and learn how to navigate today's health trends. This meeting is the premier event for actuaries working in the health industry.

Highlights of the meeting include:

- » Integrated delivery systems
- » Blockchain innovation in health care
- » Health care costs
- » Public health—more important now than ever
- » Specialty drugs

Choose from more than 100 thought-provoking sessions. Register today at SOA.org/HealthMeeting.

ING TRENDS



Tool

Climate Index

The current data from the Actuaries Climate Index reveals the five-year moving average of climate extremes remains at the high recorded in winter 2016–2017 for Canada and the United States. This was driven by sea level changes in the Atlantic and Gulf Coast regions. The index was jointly developed by the SOA the American Academy of Actuaries (the Academy), the Canadian Institute of Actuaries (CIA) and the CAS. Read more about the findings at ActuariesClimateIndex.org.

bit.ly/ACI-Spring2017



Listen at Your Own Risk

The SOA's new podcast series explores the thought-provoking, forward-thinking topics across the spectrum of risk and actuarial practice. Listen as host Andy Ferris, FSA, FCA, MAAA, leads his guests through lively discussions on the latest actuarial trends and challenges.



Listen
at your
own risk



Visit SOA.org/Listen to
start listening.

Timeless

THE PAST, PRESENT AND FUTURE OF THE SOA



This box and gavel were made of timber from the roof & screen of the XVI cent STAPLE INN HALL for 57 years the home of the INSTITUTE of ACTUARIES destroyed by a flying bomb in August 1944



1949

The Society of Actuaries (SOA) held its first meeting Nov. 14–16, 1949, at the Greenbrier Resort in White Sulphur Springs, West Virginia. History indicates it was an auspicious occasion. One of the gifts presented to the SOA at this meeting came from England’s Institute of Actuaries. The gift—the box and gavel—were made from timber from the 16th century Staple Inn, home to the Institute for 57 years. Sadly, the inn was destroyed by a bomb in 1944. The box and gavel are among the SOA’s most endearing treasures.

Send us information about SOA historical artifacts that will enlighten everyone about our organization’s past, and serve as a springboard for future growth, as the actuarial profession continues to inspire and evolve. Write to theactuary@soa.org and share.

2018 HEALTH MEETING

JUNE 25-27 • AUSTIN, TX

Navigating Today's Health Trends

Save the date for the **2018 SOA HEALTH MEETING** where you'll gain current information on the hottest issues facing health care.



SOA.org/HealthMeeting



2018 **ANNUAL
MEETING**
& EXHIBIT

NASHVILLE, TENNESSEE
OCT. 14-17, 2018

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