

**TechCast Article Series**

**Issues in Science & Technology**  
Report of a Panel Discussion

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The four of us held a panel discussion at the annual meeting of the World Future Society in Toronto on July 30, and the outcome was so fascinating that we report it here. Our intent was to discuss at least three of the issues listed below, but the debate was quite intense, so we only made it through the first two. We offer this quick summary of our deliberations in the hope it may clarify these crucial issues in science and technology. And, indeed, by working with the audience we think we produced a consensus on the issue of global warming.

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## How Serious is Global Warming?

Popular opinion, most scientists, and even corporate CEOs have accepted the dangers of global warming, but the fact is that the rise in global temperature over the past century is within the range of previous cycles. Despite the apparent correlation of global temperature with rising CO<sub>2</sub> levels, despite several unusually warm years in the past decade, despite extraordinary weird weather like the heat spell in Europe, this could turn out to be just another blip in the Earth's natural rhythms – rather than a human-caused calamity. ***Is global warming a real threat, therefore, or just a temporary blip in nature? Can we afford to risk not taking serious action? What should be done?***

If this is a natural cycle, cutting back on oil is not likely to reduce global warming and it could incur big costs. Even if the Earth continued to warm, some scientists contend this would be beneficial because crops grow better in a hot, high CO<sub>2</sub> climate. Regions near the equator would suffer, but others closer to the poles (Canada, etc.) would benefit. ***“Peak Oil” is coming soon, so could the problem solve itself?***

Perhaps the truth lies in between. This could be a natural cycle exacerbated somewhat by carbon fuels. ***To what extent is global warming “man-made” and therefore capable of remedies? 10% human caused? 50%? 90%?***

**Bill Halal** noted that everyone except George Bush seems to have accepted the dangers of global warming now. He also noted that a meeting of 30 Fortune 500 CEOs was recently held at GE Headquarters, and the consensus was that regulations on greenhouse gases are likely when Bush leaves office in 2008.

**Ted Gordon** announced there is “precisely” an 87.5 % correlation between human causes and global warming, and that the consequences would be enormous and widespread, including the prospect of massive human migrations.

**Ian Pearson** countered by proclaiming that Ted is completely wrong – the correlation is 87.6 %. (You can see why we made slow progress.) Ian went on to say the problem was visible 30 years ago, but the opposition of environmentalists made progress impossible, as in the political case against building nuclear plants.

**Kelly Carnes** thinks that too much time and energy are being devoted to determining whether or not global warming exists, when the appropriate focus should be to transition to a post-carbon world. She believes all promising strategies that reduce dependence on fossil fuels should be pursued, including:

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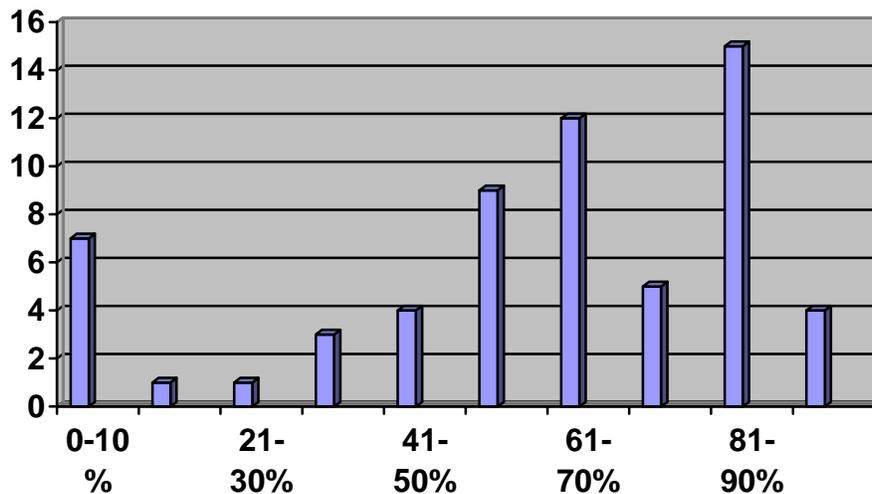
1) Develop a distributed energy grid in which countless small sources provide power, 2) Diversify into wind power, biomass, solar, and other alternative sources, 3) Use clean coal technology with carbon sequestration, and 4) significant investment in R&D, demonstration and testing for hydrogen and fuel cells.

**Jose Cordiero** (member of the audience) strongly objected to the tone of discussion, noting that the Copenhagen Consensus (a ranking of global threats by prominent authorities) placed global warming last.

**Walter Derzco** (member of the audience) said a study by the Intergovernmental Panel on Climate Change concluded that humans only cause 5% of CO<sub>2</sub> gases.

**Bill Halal** noted these two statements represent a sizable body of opinion opposing the popular view that global warming is largely man-made. Bill proposed a show of hands to gauge the consensus of those present, with the results below.

Table – Frequency Distribution of Responses



Estimated portion of global warming due to human causes (R<sup>2</sup>)

This data is compelling. The mean is about 60 -70 %, suggesting that futurists on average consider global warming largely caused by humans, although there is a small dissenting opinion. Another show of hands confirmed that a similar distribution thinks humans can actually solve the problem. This is consistent with TechCast's estimate that "Most nations will adopt serious measures to protect the environment about 2012. "

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## Can Science & Technology Better Serve Human Needs?

Scientific findings and technological products have always been powerful forces of social improvement, but often they have not. Nuclear weapons, traffic congestion, computer hacking, and a host of other maladies come to mind.

***How can S&T be effectively directed to avoid serious unwanted these consequences and better satisfy societal needs? Can ethical considerations be introduced into S&T and decision making? How can S&T help discourage terrorism and protect freedom?***

**Bill Halal** pointed out that technology is usually introduced by large corporations, which are primarily managed to increase profits rather than show concern for human values. Although Bill thinks a more productive form of business is possible that serves social needs as well as financial gain, there is little sign it is coming.

**Ted Gordon** pointed out the enormous needs for technology in medical care for the poor, clean water, and avoiding pandemics like the SARS virus. Government prohibitions of the type now used for stem cell research are self-defeating since they drive science abroad or underground. Instead, sound regulation is needed, as well as a “global office of technology assessment.”

**Kelly Carnes** thought science and technology are fundamentally forces of good with manageable downsides. Her preferred approach is to take steps to ensure that societal and ethical issues are considered concurrently with the performance of R&D, and noted that the US has adopted this approach in a nascent form in the National Nanotechnology Initiative. She believes this approach should be expanded both within the US, and through appropriate international bodies.

**Ian Pearson** feels dangers are intrinsic to all technology, and it is necessary to publicize them to guide the public’s choices about products. He also thought the threats today are so grave that life on this planet may become extinct by 2085. The choice is starkly clear in Ian’s words: “Without technology we are doomed; without its control we are also doomed.”

**Ted Gordon** closed by suggesting that corporate managers, engineers, and scientists should be required to study and apply ethics to scientific issues.

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The panel ran out of time at this point, but we include the following background material on three other critical issues. All panelists and the audience liked the format so much that we intend to hold it again. Tell us what you think.

Bill Halal, Ted Gordon, Kelly Carnes, and Ian Pearson

## **Are the Promises of Nanotechnology Achievable?**

Great advances are underway in nanotechnology, and TechCast estimates 30% of products will use nanotech by 2019. But this is not what Erik Drexler envisioned. Rather than constructing “robotic assemblers” churning out endless customized molecules and organizing them into any type of product, the focus is on carbon nanotubes. ***Is Drexler’s vision feasible? If so, when would we start approaching it?***

Even within the present “nanotube paradigm,” it is proving extraordinarily difficult to organize nanotubes for useful purposes. Yes, memory chips are being constructed with extremely high data densities, but a microprocessor is altogether different. “It’s not something I can foresee any time soon,” said one nano-entrepreneur. ***How long, if ever, will it take to build a commercial computer using nanotech?***

There is a great hope for using tiny objects that seek out and destroy malignant cells, such as cancer. ***Is this really feasible?*** It is now being discovered that nanotubes dissolve in water and that they can damage microorganisms. ***Would you allow a physician to inject billions of these objects into your bloodstream?***

## **Artificial Intelligence vs. Human Consciousness**

***Is there a fundamental difference between machine intelligence and human intelligence?*** Despite the fact that about 90% of us are utterly convinced that “human thought” surpasses sheer information, could we be wrong? Everybody once accepted the Flat Earth model for millennia.

The Japanese will be living with smart, all-purpose androids soon, and computer power will match the brain about 2020. TechCast data estimate 30%

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of modern people are likely to use androids by 2017. In addition to Asimov's laws, ***what will it be like to live with androids? How closely will robots, virtual assistants, and other forms of AI approach human capabilities?***

If AI can't fully meet this "Turing Test" as 2020 approaches, ***will we accept the existence of a domain "Beyond Knowledge?"*** The Dalai Lama is working to integrate neuroscience and Zen philosophy. I think he would argue that the mind involves some kind of "higher" power that coexists with the physical world and with information in complex ways. ***Is he right?***

TechCast data suggest IT will top out about 2020 as the global grid matures, shifting attention to a new stage of development. ***What follows the Knowledge Age?*** AI should be pretty good then, automating routine aspects of human intelligence. ***What "higher" role will humans serve in a world of abundant AI? Could the period around 2020 introduce an "Age of Consciousness?" What would that really mean?***

## **Can Quantum Computing Become Practical?**

Quantum computing is a computer scientist's dream because storing information in atomic particles offers enormous possibilities. A particle can co-exist in two places simultaneously in the quantum world (super imposition), allowing infinite computing power. The basic unit of quantum computing is a "qubit" - the state of a particle spinning either clockwise or counterclockwise, representing a 0 or a 1. Because superimposition allows particles to be in two places simultaneously, altering the state of one electron can produce two qubits, two electrons can produce four, three electrons eight, and twenty electrons could perform a million computations instantaneously. This exponential growth offers the potential of infinite computing power. A quantum computer could easily complete in seconds a task that takes a silicon computer billions of years. In fact, simple applications of quantum computing are working now, providing perfect cryptography.

But storing data in particle is truly heroic - cryogenic temperatures, powerful magnetic fields, exotic gases, etc. And there are doubts about controlling particles for more than a fraction of a second. ***Is it reasonable to think we could create entire computers managing endless particles? How would they be controlled to produce calculations? What instruments would be used to read the results? Could this complexity and cost be reduced to develop ordinary PCs?*** TechCast estimates the first commercially available quantum computer to appear about 2022, but experts' average confidence in this forecast is only 57%.