Why caring about climate change means caring about chemicals of concern

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Finally. Climate change has risen to an unprecedented level of mainstream public discourse with the ramping up of 2020 presidential campaigning in the U.S. In just five years, the number of Americans believing climate change is a threat to our country has increased by 49%. Globally, this view is now held by more than two thirds of people across 23 countries surveyed by the Pew Foundation, with climate at the very top of a threat list that includes terrorism, cyberattacks, North Korea's nuclear program, and the global economy.

If the trajectory of these perceptions translates quickly enough to sufficient action, there will obviously be much to cheer. But meanwhile, there's a quieter discussion on a seemingly parallel but separate track that risks getting too overshadowed in the battle for public and corporate mindshare. Yet its climate change implications are profound. And that discussion is about chemicals of concern.

It's far too crude a measure to point out that, for example, climate change gets 834 times more attention in Google searches than does "chemicals of concern," 40 times more than "toxic chemicals," and 38 times more than "hazardous substances" – or nearly 20 times more than all three combined. The thing is, *climate and hazardous substances are much more closely intertwined than most people think*. That includes most consumers, economists, policy makers, politicians and even corporate sustainability professionals.

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If we can raise awareness of the connections between climate and chemicals and the human health implications, there will be greater support for and appreciation of green chemistry as an integral part of addressing our climate crisis. That will simultaneously translate to accelerating climate change mitigation and improvements in both health and productivity.

Why? Let's start with some simple truths about how the proliferation of chemicals of concern is even more threatening in a hotter world, as well as making the world even hotter still. For example:

- The toxicity of air pollutants and pesticides is exacerbated by hotter temperatures, which impact the way these chemicals are distributed in the environment and absorbed by our bodies (and all species). The more pollutants, pesticides and other chemicals of concern, the more toxicity present in the environment that can be adversely acted upon by global warming.
- Hotter temperatures weaken the ability of humans and animals to cope with chemical toxicity, inhibiting metabolism and excretion necessary to detoxify the body.

- Inversely, the suppressed immune systems of chemically compromised bodies are less capable of withstanding climate change effects including extreme temperatures, severe storms, tainted water or food shortages.

- The more chemicals of concern in the environment, the more runoff contamination of watersheds from increased intensity and frequency of storm events as well as storm surge contamination of coastal water supplies – contamination that ultimately finds its way into our bodies and imperils biodiversity. Also, flooding events not only produce mold in buildings, but release hazardous chemicals like formaldehyde from wood products and plasticizing chemicals from flooring products that have not been sustainably manufactured.

- Hotter temperatures make the increasing quantities of chemicals in the ground and water much more likely to become airborne health risks, and allow them to travel great distances.

- The overwhelming majority of harmful organic solvents are petroleum-based (92% of all organic chemicals are petroleum-based), the production of which intensifies climate change in all the ways that fossil fuels do.

- Some chemical companies are working hard to reduce energy consumption, but the fact is that tremendous amounts of non-renewable energy are used in production of hazardous substances such as sulfuric acid, nitrate-based fertilizers, soda and caustics, cement, and pharmaceutical and organic chemicals. (Where this has been carefully studied in Switzerland, for example, chemical and pharmaceutical production exceeded all other industrial sectors in energy use and was responsible for 25% of total industrial CO_2 emissions.) These processes not only exacerbate climate change directly via emissions, but also through indirect effects such as wastewater that pollutes soil and underground water when untreated and generates solid and slurry waste. The energy supply required for these manufacturing processes also indirectly charges the environment with emissions of sulfur dioxide, nitrous oxides and particulate – yet more reasons that reducing production and use of chemicals of concern translates to less warming of the planet.

Fighting Climate Change with Green Chemistry

Given all the above, I find it astonishing how seldom the proliferation of hazardous chemicals is present in the climate change discussion and the plans to mitigate it – especially when we consider the powerful solutions emerging from advances in green chemistry. As an example, with the proviso that there is wonderful work underway in many places across the globe on this front, let's look at one source of green chemistry solutions and how such solutions relate to climate change.

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The very important work of the [Warner Babcock Institute for Green Chemistry]() (WBI) is a lighthouse that shows the way. Many people still think that green chemistry equals safer products that cost more and don't perform as well. For more than a decade since its founding, WBI has consistently debunked this by not even considering chemical alternatives to be Green Chemistry unless they are not only more benign than existing chemicals, but also more economically viable and as good or better on performance. With their partners they have repeatedly [invented such solutions](), with exciting future breakthroughs in the pipeline. But how this all impacts climate change is less obvious to the casual observer. Yet it's powerfully significant when considered in the dual contexts of global warming and the 12 principles of Green Chemistry that WBI espouses and that have become pillars of safer chemical development around the world.

So let's make some connections here. At the end of this article is a table where I've shown how chemicals impact climate in the context of those 12 principles. (Don't be put off by some of the chemistry terminology in Principles #8 and 9; I'm certainly no chemist, but us lay people can get the hang of it – and the links provided can help too.)

The bridge between all this green chemistry potential and achieving results at scale is this: finding ways of making it easier for companies to identify and source safer, sustainable substitutions for chemicals of concern. That's where substitution enablement solutions come in.

Making It Easier to Substitute Safer Chemicals

As with green chemistry itself, far too seldom are the connections made to climate change when considering the ways in which NGO's are helping companies more easily and confidently find safer substitutes for hazardous substances. Again, with the proviso that very good work on this comes from multiple organizations as well as internal methodologies at some of the world's more enlightened chemical companies, let's look at the example of the NGO Clean Production Action and how its efforts relate to climate.

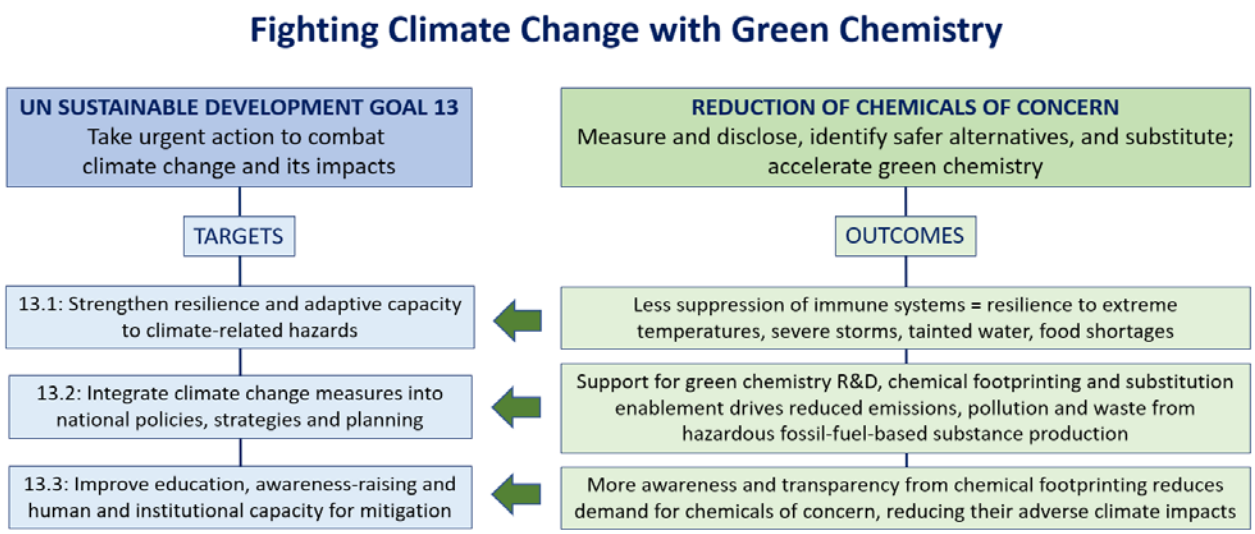
Clean Production Action provides strategies and tools to simplify for companies the complexity of substituting safer chemicals and materials for hazardous ones. Its globally used GreenScreen benchmarking tool helps companies and governments identify chemicals of concern and find safer alternatives, and track progress. In tandem, its Chemical Footprint Project enables companies to measure and more transparently disclose their chemical footprints, further incenting them to reduce hazardous chemical use.

Green chemistry's potential to help with climate is constrained by how challenging clean production is even for the best-intentioned companies. Solutions that facilitate safer substitution are key. The first principle of clean production – knowing and disclosing product chemistry – is the on-ramp to mitigating all of the issues highlighted earlier in this article. Despite the well-deserved credit that has accrued to Clean Production Action's programs and other safer chemicals initiatives, too seldom is there recognition that every reduction in hazardous chemical use represents a reduction in the damaging interactions between these substances and the macro environment of a hotter, scarcer world.

Takeaway: We Can't Care About Climate without Caring About Chemicals

We must recognize that climate and chemicals are closer cousins than has generally been acknowledged. We must recognize that green chemistry, paired with strategies and tools for safer substitution, can be and has to be a bigger part of the arsenal in attacking climate change. As our existential climate challenges mount, all the galvanized action to attack them can be amplified if green chemistry is fully seen and supported by policy makers and company decision-makers. Its power to mitigate both the human health and environmental impact of the warming of the planet cannot be left partially untapped.

All of this is more simply understood in the context of the United Nations Sustainable Development Goal #13's targets for urgent climate action.



So *next time you think about climate change, think about chemicals*. It's all one issue, inseverable, in our interconnected web of environmental and health challenges in this anthropomorphic era of climate shock and chemical proliferation.

If you care about climate change's impact on human health and survival, ask yourself and your company or organization this: what more can I/we do to reduce demand for chemicals of concern, replace them with safer alternatives, and support advances in green chemistry? Underutilizing such a powerful weapon in the fight to save our planet and ourselves is no longer an option. We have too much catching up to do!

Steven Cristol is founder and managing partner of Strategic Harmony® Partners and an Advisor in DBI Network, a global management consultancy. He has counseled some of the world's most innovative companies on brand strategy and product strategy, and his business books for Free Press and McGraw-Hill have been published in 11 languages. He holds a patent for the first decision model and process for optimizing product development choices to create value and align product strategy with brand strategy. His current work includes advancing integration of sustainability into product development decisions. Steven can be reached at cristol@strat-harmony.com.

The 12 Principles of Green Chemistry*	Climate Change Impacts
Principle #1. It is better to prevent waste than to treat and clean up waste after it is formed.	Traditional waste management contributes up to 5% of total greenhouse gas emissions. Up to tenfold

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	reductions in waste have been achieved by green chemistry.
Principle #2. Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.	Without green chemistry, it's not unusual for half the atoms in a manufacturing process to end up as unwanted by-products outside the product itself. Those may include solvents and separating agents that are toxic pollutants to be further exacerbated by warming temperatures.
Principle #3. Whenever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.	Fossil fuel-based plastics manufacturing is a prime example of processes that ultimately compromise the body's ability to cope with climate change impacts even as those processes directly contribute to climate change. PVC, polystyrene, and polycarbonates are all made from carcinogens and endocrine disruptors. Advances in using enzymes and proteins in place of solvents are a huge opportunity for green chemistry to help mitigate climate change while protecting our ability to cope with it, especially as demand for plastics and polymers quadruple, by some estimates, by 2050.
Principle #4. Chemical products should be designed to preserve efficacy of the function while reducing toxicity.	Traditional chemistry has been focused on achieving molecular reactions and transformations with far too little collaboration between chemists and toxicologists. Green chemistry designs products with toxicology and ecology uppermost in mind, protecting the environment and the ability of humans and other species to cope with a harsher climate.
Principle #5. The use of auxiliary substances (solvents, separations agents, etc.) should be made unnecessary whenever possible and, when used, innocuous.	Solvents account for three quarters of the cumulative environmental impacts of standard batch chemical operations. As we start to see more plant-based substitutions (just one example being nail polish remover with acetone made from corn instead of toxic benzene and propylene), reductions in emissions and waste follow.
Principle #6. Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted to ambient temperature and pressure.	Most chemists don't think about how temperature and pressure impact energy use and waste, or how removal of solvents accounts for most of the energy used in their processes. Green chemists do.
Principle #7. A raw material or feedstock should be renewable rather than depleting whenever technically and economically practical.	Nature produces about 170 billion tons of plant biomass annually, of which we currently use about 3.5 percent for human needs. It is estimated that about 40 billion tons of biomass, or less than 25 percent of the annual production, would be required to completely generate a bio-based economy. The more use of biomass feedstocks, the lesser the negative impacts on climate change, human health, and biodiversity.
Principle #8. Unnecessary derivatization (blocking group, protection/deprotection, temporary modification of physical/chemical processes) should be avoided whenever possible.	Advancements in the use of enzymes in place of chemicals of concern in production of antibiotics, for example, detoxifies the process. With some 800 million pounds a year of antibiotics produced, green chemistry impact at scale is another great opportunity for reducing climate impacts as enzymes also require less energy than chemical catalysts to activate a chemical transition in manufacturing.

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Principle #9. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.	The first type of reagent referenced would be, for example, an enzyme from renewable resources; the latter type generate enormous amounts of waste and require fossil fuel energy resources. Green chemistry substitutions like this are key in reducing petrochemical industry impacts on climate and health.
Principle #10. Chemical products should be designed so that at the end of their function they do not persist in the environment and instead breakdown into innocuous degradation products.	Once chemicals have done their primary job, they end up in landfills or water, soil and air. The faster and more completely that chemicals degrade, the less exposure to them in the environment and the less they are exposed to the exacerbating effects of climate change. Green chemistry addresses how to minimize or even eliminate persistence of substances that magnify climate change impacts and that create health hazard on contact with our bodies, other species, and the marine environment. Biodegradable soaps and detergents were a great start, but there is so much more that green chemistry can and will do.
Principle #11. Analytical methodologies need to be further developed to allow for real-time in-process monitoring and control prior to the formation of hazardous substances.	Chemical production processes can deviate from intended ranges and, in the process, increase temperatures, poison catalysts, and intensify substance hazard. Green chemistry includes real-time monitoring methods to prevent such adverse outcomes that may increase energy use as well as toxicity.
Principle #12. Substance and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions and fires.	This is really an overarching safety principle inherent in green chemistry. We all know or know about the horrors of chemical production accidents and toxic releases and emissions that ensue. Important not only the general public, but certainly to the workers who are exposed to accidents at point blank range.

*Source: Warner Babcock Institute for the principles; impacts are this author's selected examples.