



# Drexel Policy Notes

## Climate Change and the Future of the North American City

Fifteen of Drexel's environmental experts weigh in on what Philadelphia will look like in 2100: With contributions from Peter DeCarlo, Richardson Dilworth, Jerald Fagliano, Erin Graham, Patrick Gurian, Charles N. Haas, Simi Hoque and Hamed Yassaghi, Christian Hunold, Hugh Johnson, Alison Kenner, Scott Gabriel Knowles, Stefanie Kroll, Jose A. Tapia, and David Velinsky.



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# Climate Change and the Urban Future

Richardson Dilworth

Along with the rest of the world, Philadelphia will experience fundamental, life-altering, and deeply disruptive changes over the 21<sup>st</sup> century as temperatures and sea levels rise. As the most recent report of the International Panel on Climate Change makes clear (on the basis of more than 6,000 scientific studies), these changes are now unavoidable and the only question is the extent to which rapid, coordinated, and significant global efforts to curb greenhouse gas emissions can help us avoid more devastating changes. Previous human responses to catastrophes provide some basis for hope, but the challenge of addressing climate change also begs the question of whether humanity has the capacity to meaningfully address such a profound and existential threat that is largely a product of our success as a species.

The impacts of climate vary by region, and this collection of brief essays by many of Drexel University's environmental experts looks specifically at how climate change will affect the region in which we all live, Philadelphia, by 2100—roughly the time when many of the authors of these essays might expect their great-grandchildren to be working-age adults.

The essays—a combination of somewhat technical forecasts combined with speculations about what life in the city will be like in 82 years—all suggest that those great-grandchildren would most likely still be able to live in Philadelphia, but that the city will be much hotter, and many of the neighborhoods along the Delaware River will no longer be habitable due to flooding or may simply be permanently under water. There will be a greater risk of diseases and of catastrophic storms, and undoubtedly there will have been

significant property losses. At the same time, several authors suggest that we might experience greater demand for housing as refugees come in from places that have become uninhabitable.

As a city there are limits to what we can do to address climate change, but what we can do is not insignificant. More trees will reduce the impact of rising temperatures. Wetlands restoration will reduce the impacts of floods. Smart investments in infrastructure and new regulations such as building codes can anticipate such things as increased storms, flooding, and greater energy demands. There are of course also many things we simply don't know and for which we thus can't prepare. We have a limited understanding of how climate change might impact food access in our region or of the extent to which we will have to accommodate climate refugees. And we have a limited ability to predict responses to climate change at higher scales, and how those responses will affect life in specific cities.

It seems somewhat of a stretch to hope that readers might enjoy the essays herein, but our hope is that they might at least inform and inspire, either out of hope or fear—or, for better or worse, the chance to make a profit.

#### ABOUT THE CONTRIBUTOR:

*Richardson Dilworth is a professor, director of the Center for Public Policy, and interim head of Drexel's Department of Politics. He is the author of The Urban Origins of Suburban Autonomy (2005) and the editor or coeditor of seven books, one of the more recent being, with Christine Palus, The CQ Press Guide to Urban Politics and Policy in the United States (2016).*



# Remember Fishtown?

Christian Hunold

Following the catastrophic sea level increases of the 2060s and 2070s hundreds of thousands of climate migrants displaced from coastal towns found refuge in Philadelphia. When regular flooding destroyed the city's riverfront neighborhoods in the 2040s—remember Fishtown?—there had been no economically feasible alternative to letting much of the land along the I-95 corridor revert to marshland. However, this turned out to be a blessing in disguise insofar as storm surges rarely made it west past Broad Street, even during exceptionally high tides.

The majority of refugees from New York and New Jersey—homeless after their cities were swallowed by the sea in a few short years—had found shelter (such as it was) throughout the city's poorest neighborhoods in North and West Philadelphia, eventually revitalizing areas that had stagnated for much of the 21<sup>st</sup> century. The irony of returning to neighborhoods their great grandparents had left behind in the late 20<sup>th</sup> century was not lost on the displaced.

The city's footprint had shrunk by about a quarter while its population had nearly doubled. Still, life in many neighborhoods was not unbearable, all things considered. The original designers of Green City, Clean Waters (the city's ambitious green infrastructure plan for stormwater capture, initiated in 2009) could not have foreseen this in the 2010s, but aggressive investment in urban greening had made all the difference in protecting the city's viability after the age of cheap energy had come to a brisk end.

To be sure, sweltering nighttime temperatures of well above 80 degrees from April to October were no picnic—only the wealthiest citizens with homes located in relatively cool locations could expect to live into their 60s or even 70s—but the city’s expansive, heat-tolerant tree canopy moderated the urban heat island such that temperatures did not stray too far above the range people in the early 21<sup>st</sup> century would have considered desirable, if not necessary to support human life. Even though the tropical climate eventually took its toll on people’s bodies, the young and healthy still managed to lead productive, if somewhat shortened lives.

ABOUT THE CONTRIBUTOR:

*Christian Hunold is an associate professor in Drexel’s Department of Politics. His research focuses on green politics and environmental political theory, human-animal studies, and urban sustainability.*



# How We Respond Now Will Determine Philadelphia's Fate in the Next Century

Hugh Johnson

One of the key messages of the recent special report of the Intergovernmental Panel on Climate Change is that “we are already seeing the consequences of a 1° C average rise in global temperature in the form of more extreme weather, rising sea levels, and diminishing Arctic ice.” While limiting warming to 1.5° C is still technically possible, global average temperature will continue to rise in coming decades due to current emissions, and as emissions will likely continue to rise. How the world responds over the next couple of decades will determine what additional consequences we’ll face in Philadelphia at the end of this century. In 2014 the Philadelphia Office of Sustainability commissioned a study that looked at Philadelphia’s past and present climate and compared it to what it might look like in 2100 under different warming scenarios. Under all scenarios Philadelphia will experience a warmer and wetter climate than in the recent past, from 1961 to 2000.

Currently Philadelphia experiences approximately 18 days a year where the maximum daily temperature exceeds 90° F and approximately 4 days per year above 95° F. By the end of the century Philadelphia could experience between 17 and 52 days that exceed 95° F and between 2 and 16 days a year exceeding 100° F. Along with increased temperatures we will experience a rise in precipitation which will lead to increased flooding, erosion and possibly an increased risk of water borne diseases. While the increase in occurrence of heavy or very heavy rainfall events is projected to be minimal, the overall amount of precipitation, due to more rain events, could lead to as much as 60% more precipitation during the

#### ABOUT THE CONTRIBUTOR:

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winter months. As a coastal city situated on the tidal Delaware River, Philadelphia is more vulnerable to sea level rise than the average Philadelphian perceives daily.

Utilizing the National Oceanic and Atmospheric Administration's Sea Level Rise Viewer ([coast.noaa.gov/digitalcoast/tools/slr.html](http://coast.noaa.gov/digitalcoast/tools/slr.html)) there is a range of impacts that Philadelphia may experience by the end of the century. Under an intermediate or moderate scenario most of the Navy Yard, portions of Philadelphia International Airport and surrounding neighborhoods, most of the former Sunoco refinery, portions of Philadelphia east of Columbus Avenue and large sections of Camden would be completely underwater. Under an intermediate high to extreme scenario the entire Philadelphia International Airport and all surrounding neighborhoods in southwest Philadelphia, the entire Navy Yard, all of the neighborhoods located east of Delaware Avenue, and all of Camden and shore points immediately south would be completely inundated with water. These impacts are in the absence of high-tides, flooding, or hurricanes, which would expand the areas underwater temporarily.

Other impacts that are less definable or understood include increased levels of ground level pollutants as a result of higher temperatures, exacerbating health problems; ecosystem level changes as plant and animal species endemic to our area move north while southern species expand northward; and reductions in crop yields due to higher temperatures and impacts from extreme weather events.



# An Optimistic Scenario: Strict Global Regulation and Higher Taxes

Erin Graham

Rising temperatures make all global problems worse. Mass migrations that exacerbate refugee crises, wars caused by drought and food shortages, and the spread of vector-borne diseases across borders are all expected to rise sharply long before 2100. The international community has so far struggled to negotiate an ambitious international agreement with teeth to curb greenhouse gas emissions (GHG), but this will change as conditions in the 21<sup>st</sup> century worsen. GHG emissions will be tightly regulated at the international level.

Along with other cities, Philadelphia will be subject to global oversight of its energy production and use. Much like suspected violators of the nuclear non-proliferation treaty are subject to inspection by the International Atomic Energy Agency, suspected violators of emissions agreements will receive visits from international inspectors. The consequences of climate change will dictate that penalties for excessive emissions will be severe and swift—think international isolation via economic sanctions and a harsh inspections regime. In 2100, we will also pay higher taxes to finance an increased foreign aid budget as problems in developing countries escalate alongside steadily growing demand for domestic responses to climate-induced emergencies.

Strict global regulation and higher taxes in Philadelphia represent an optimistic scenario. In another plausible scenario, the US remains shortsighted, world powers fail to curb emissions, and in 2100 the world is characterized by disorder and chaos.

#### ABOUT THE CONTRIBUTOR:

*Erin Graham is an assistant professor in Drexel's Department of Politics. Her research focuses on international institutions, climate change, and global health.*



# A Hotter City with More Energy Demands

Simi Hoque and Hamed Yassaghi

We modeled predicted building energy consumption of large, medium, and small office buildings in Philadelphia to understand the energy impacts of climate change. Our estimation\* is that, by 2100 in Philadelphia:

- The annual average mean temperature will increase to 17.3°C (63.14°F), compared to the 1961-1999 average of 12.4°C (54.32°F).
- New buildings will have an increase in cooling requirements by 68.2% for small offices, 50.4% for medium offices, and 53.4% for large offices.
- Applying all reasonable building energy mitigation factors did not result in straightforward improvements or reductions in energy consumption.

The first two findings are particularly alarming, not only from the point of view of building energy consumption and demand, but also because it affects electricity generation and transmission of power plants. We are also aware that mitigation factors, such as improving building envelope performance (decreasing window U-factors, reducing air infiltration) or reducing lighting density, may not yield optimal results, which complicates the development of climate action plans and sustainability policies.

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\* This estimation relies on the A2 scenario of the Intergovernmental Panel on Climate Change. See [www.ipcc.ch/ipccreports/sres/emission/index.php?idp=98](http://www.ipcc.ch/ipccreports/sres/emission/index.php?idp=98)

Our model does not tell us about the impacts of climate change in Philadelphia in terms of public health, urban livability, and economic resilience. Unless we find a way to include these qualitative indicators in our model, we do not have a reasonable expectation of what will happen to Philadelphia in 2100.

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# Perhaps Naively, My Optimism Kicks In

Stefanie Kroll

Temperature and precipitation changes for 2100 around the Philadelphia area (hotter by 4–6° F, and a 5–15% increase in precipitation, from slightly outdated NASA 2013 visualizations) look minor at first glance, compared to the southern United States and the poles. But temperatures on land will be higher than those of the ocean. And changes in the poles will not seem so irrelevant to Philadelphians once weather patterns continue to change worldwide. Sea levels will rise due to a combination of melting ice and increased ocean volume due to warming temperatures. The ocean will be seeping onto the coasts, but how far? The recent IPCC report is very clear that we will be feeling the effects by 2030 if we don't get serious about taking action now.

Even as a scientist I have a hard time visualizing the drastic changes predicted, but that's exactly the problem. One psychologist said that convincing people they are affecting the climate is as big a shift in thinking as the idea of natural selection and evolution, or that the earth is not the center of the solar system. In the meantime, business is going on as usual, and until policymakers act on cutting emissions, we can't expect to be on anything but a crash course for disaster.

My imagination runs wild with all the interactions that will be happening with the changing climate and the effects of pollution and other human activities. For all living communities, there are continuing range shifts, declines in biodiversity, altered life cycles, different energy resources and availability, new agricultural models, and, of course, mass migrations of climate refugees. Will

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Philadelphia be a sanctuary city for climate change, or will we have to look for a new place to settle? Will agriculture be adapted to current declines in total insect abundance, altered soil conditions, increased populations, changes from petroleum-based fertilizers, and water scarcity? Even if we do not face regional scarcity, we will be part of a national and global problem, requiring interbasin water transfers. Will we have enough food to sustain everyone? What will my middle class budget buy me? What about families below the poverty line?

Perhaps naively, my optimism kicks in. We can convince policymakers and industry to take measures to reduce the effects, no matter what they believe to be the cause of climate change. We will continue to develop technologies and solutions to manage these changes and live in a more sustainable, albeit stressed, world. Every country will have to open their borders to world citizens whose ecosystems have become uninhabitable by very high temperatures, more regular drought, and land that is sinking into the ocean. Clean energy and overall reductions in consumption must become the status quo. Fresh water has to be protected, not privatized, and derived from recycled wastewater. We will find ways to get through hotter summers, heavier storms, storm surges, and stresses on our infrastructure. But this will only happen when we stop thinking that our comfortable world of 2018 will persist.



# We May Find Ourselves Better Off in Other Ways

Peter DeCarlo

There are virtually no scenarios, save nuclear conflict,\* in which the climate in 2100 is the same or cooler than the one we currently live in. That being said, depending on what actions we collectively take as world citizens, we may find ourselves better off in other ways.

Reversing the business as usual trajectory towards unmitigated warming requires massive investment in non-fossil-based energy systems and full electrification of transportation sectors in the western world and investments in electrification in much of the Global South. The result will be significantly cleaner air.

Tailpipe emissions, heavily polluting industries such as the Philadelphia refinery, and unconventional natural gas extraction will be a thing of the past as we commute and travel with electrified autonomous vehicles powered by renewables or other non-fossil energy sources. Reductions in emissions from the fossil fuel industry and associated use will lead to significantly cleaner air in urban areas like Philadelphia. Efforts to mitigate climate change will also result in greening of cities for both carbon sequestration and reducing urban heat island effects. While the future climate will undoubtedly be warmer, well designed investments in non-fossil infrastructure will provide for a cleaner and more livable Philadelphia.

## ABOUT THE CONTRIBUTOR:

*Peter DeCarlo is an associate professor in Drexel's Department of Chemistry and Department of Civil, Architectural and Environmental Engineering. He heads the Drexel Air Resources Research Laboratory in the College of Engineering.*

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\* See Andrea Stenke et al., "Climate and Chemistry Effects of a Regional Scale Nuclear Conflict," *Atmospheric Chemistry and Physics* 13 (2013): 9713-9729.



# Will Philadelphia Become More of a Haven for Infectious Diseases by 2100?

Charles N. Haas

With increasing temperature, humidity and rainfall will come increases in infectious diseases. We know that during wetter, warmer periods, Legionnaire's disease rates increase. There are other infectious diseases that have similar life cycles which may increase as well.

We may see insect disease vectors, more often associated with semi-tropical environments, increase in importance in Philadelphia. In the absence of more effective insect and vector control programs, the associated diseases (such as West Nile, Zika and perhaps the viral encephalitis diseases) will increase. These will cause a burden in terms of increased illnesses, deaths, and costs imposed on our health systems.

Can these public health impacts and costs be prevented? Almost certainly. Will they be? This depends on the political will to implement technological changes, including those that will require lifestyle changes, to not just bend the curve of climate change, but to start to reverse it.

#### ABOUT THE CONTRIBUTOR:

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# The (Un)breathable City

Alison Kenner

By 2100, Philadelphia will be less breathable and asthma will be more difficult to live with. Though the city's sustainability policies will certainly help to lessen the burden of future asthma incidence, morbidity, and mortality, there are extraneous factors that will cause asthma prevalence rates to rise.

Asthma is a chronic respiratory disease that produces a wide range of symptoms under an equally wide range of environmental conditions; pollen, air pollution, chemicals, smoke, and mold all trigger symptoms, which can escalate into full-blown, potentially deadly asthma attacks. Currently, Philadelphia's asthma prevalence rates are twice the national average among children, and the city has been consistently ranked as one of the worst in the United States to live in with asthma.

There are three reasons the asthma epidemic could become more widespread and burdensome in Philadelphia by 2100. We can do something about two of these things now and into the future. The first issue is mold, which has become a huge problem for many of Philadelphia's public schools, and a core risk posed by the city's aging housing stock. With projections that the city will become warmer and wetter over time, mold will find more hospitable building environments. The city can head this off with more robust housing policy (including more robust financing for affordable homes) and by upgrading public school infrastructure.

The second issue is air pollution, which is also projected to worsen with rising temperatures and CO<sub>2</sub> levels. Here, the city can build on existing efforts to reduce building emissions, upgrade transportation infrastructure, and transition to clean energy.

The third issue—which is much harder to address through local policy—is pollen. Longer pollen seasons, higher pollen counts, and increased pollen allergenicity is projected to make asthma very difficult to live with; the pollen dynamic could lead to more cases of asthma as well. Global reduction in CO<sub>2</sub> emissions is the most powerful response to the public health risks posed by pollen. Certainly Philadelphia can take the lead here, but concerted effort is needed to make a difference for the asthma and allergy sufferers of 2100.

#### ABOUT THE CONTRIBUTOR:

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# Energy System Changes Came Too Late but Prevented the Worst Consequences

Jerald Fagliano

As we look back at the past century from the year 2100, we can be thankful that the most dire projections of climate change made in the 2030s have been avoided. Despite the upheavals of the 2020s, Philadelphia and many other US cities managed to achieve great reductions in energy usage and greenhouse gas emissions by the middle of the century. These reductions were accomplished through transformative changes in energy sourcing for transportation and electricity generation that followed the restoration of democratic institutions in the early 2030s. These energy system changes came far too late—in the US and elsewhere around the world—to keep global warming to a minimum but were nonetheless effective at preventing the worst consequences. Still, the Philadelphia region grew steadily hotter over the 21<sup>st</sup> century, and population impacts are clear.

There are now over 40 days each summer when the high temperature exceeds 95° F, up from just a handful of days earlier in the century, but not as awful as the worst-case possibility of 80 days over 95° F predicted in the 2030s. The intensity of heat is worse in Center City and other core neighborhoods compared to surrounding suburbs. However, efforts in previous decades to plant shade trees and encourage reflective roofs and streets had a beneficial effect in some neighborhoods, and many people now have daily access to cooled spaces both above- and below-ground. But not all have shared equally in these benefits. Those living in poverty—particularly children and the elderly—find it much more difficult to escape

the increasingly hot conditions in some neighborhoods of the city, resulting in higher rates of heat-related illness and death among the poor. These inequities are made increasingly worse as the Philadelphia region struggles to assimilate sea-level-rise refugees from coastal communities, as well as heat and drought refugees relocating to the northeast from the now-unbearable Sun Belt.

ABOUT THE CONTRIBUTOR:

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# More Storms, Flooding, and Chances for Invasive Species

David Velinsky

I expect low lying areas, like the Tinicum wetlands around the Philadelphia International Airport, to flood much more over the next 30 to 50 years, or even sooner depending on wind, tides and rainfall. With regards to rainfall, I wonder how our storm water system will handle increased downpours from high volume, high intensity storms. Water will most likely back up, causing flooding in the streets and of buildings. That's why it's so important to improve the green infrastructure around the city and in the suburbs. With regards to temperature and humidity, there will be a need to increase air conditioning in many buildings, thus increasing power usage and trapping heat in the city. Maybe green roofs and painting roofs could help. The increase in night time temperatures and degree days will cause a shift in plant growth and flowering along with new chances for invasive species. Many of these items are already being seen in our area and other urban centers to some degree.

## ABOUT THE CONTRIBUTOR:

*David Velinsky is a professor and the head of Drexel's Department of Biodiversity, Earth and Environmental Science. He is also vice president for academy science at the Academy of Natural Sciences of Drexel University.*



# Planning for Climate Change

Scott Gabriel Knowles

From William Penn’s “Greene Country Towne” of the 17<sup>th</sup> century to Edmund Bacon’s post-World War II reconfiguration, Philadelphia is one of the most consistently and successfully planned (and re-planned) cities in America. These future visions have not always anticipated the realities of social and economic change, but the tradition is nevertheless a strong one. With the latest report of the Intergovernmental Panel on Climate Change in front of us, it has become evident that Philadelphia will once again require an effort of planning to imagine an urban form flexible enough to withstand the environmental shock that is unfolding.

This need for planning will be most evident in water—especially the management of excess water arriving in the form of riverine floods and intensifying storms. As it is, the city’s antiquated combined sewer system overflows during heavy rains and flooding events. This poses an unacceptable health risk to the population that will only grow worse over time. But, this is only the beginning of the concern. A direct hit from a hurricane, an event that predictions indicate will grow more likely throughout the century, will expose the degree to which the city is unprepared to protect structures from the ravages of a serious flood. The impact of Hurricane Sandy on the New York City region should be a sobering lesson for Philadelphians as they think about the need to protect people and critical infrastructures.

These worst-case-water scenarios are not a matter of if, but of when. Can the city’s planning community—including private sector and non-profit partners—work together to address deferred

infrastructure maintenance, low rates of flood insurance protection, and a culture of apathy in terms of severe storm preparedness? A re-dedication of planning resources will be necessary, and undoubtedly a dedication of talent in finance, engineering, and communication will be required. The history of Philadelphia shows a strength in “big thinking” when it comes to planning—but are we up to it now?

ABOUT THE CONTRIBUTOR:

*Scott Gabriel Knowles is a professor and the head of Drexel's Department of History. His work focuses on the history of disaster worldwide. Knowles is the author of *The Disaster Experts: Mastering Risk in Modern America* (2011), and editor of *Imagining Philadelphia: Edmund Bacon and the Future of the City* (2009).*



# Transitioning to a Low Carbon Economy

Patrick Gurian

By 2100 there is reason to hope that Philadelphia will have navigated the transition to a low carbon economy. Buildings, cars, and transit vehicles will be electrified with the electricity produced by a mixture of nuclear power, fossil fuel generation with carbon capture and sequestration, and renewables. The city and the world will then face the question of how to address the failures of the previous generation to address climate change more quickly. While the world is approaching carbon neutrality, sea levels are still rising and will rise for the foreseeable future unless actions are taken to reverse climate change. Technologies to reverse climate change by removing carbon dioxide from the atmosphere will be available but applying them on a global scale will be costly, disruptive, and politically difficult.

Philadelphia will turn towards adapting to its warmer and wetter climate with greater risk of flooding. Heatwaves will be worse and more frequent, and in response the city will increase the number of cooling centers. By 2100 it is quite plausible that a major flood will have affected Philadelphia, perhaps closing the airport and leading to large amounts of property damage in South Philadelphia. Even a major flood may produce only incremental changes to building standards and zoning, as engineers and builders learn how to harden properties to better withstand flooding, and as society becomes gradually, passively tolerant of increased risk.

#### ABOUT THE CONTRIBUTOR:

*Patrick Gurian is an associate professor in Drexel's Department of Civil, Architectural and Environmental Engineering.*



# Philadelphia in 2100?

Jose A. Tapia

Those my age will not be around in 2100. For those who are young enough, the prospects for that year, and even for prior years, are not good at all.

In 1937 the British philosopher and science fiction writer Olaf Stapledon, at the time famous for his novel *Last and First Men: A Story of the Near and Far Future* (1930), wrote *Star Maker*. The book is narrated by someone able to move almost without restrictions through time and space. He explored the universe and established contact with other intelligent beings doing the same thing. What they found was not uplifting:

... we were increasingly dismayed by the wastefulness and seeming aimlessness of the universe. So many worlds, after so much distress, attained so nearly to social peace and joy, only to have the cup snatched from them forever. Often disaster was brought by some trivial flaw... Some races had not the intelligence, some lacked the social will, to cope with the problems of a unified world-community. Some were destroyed by an upstart bacterium before their medical science was mature. Others succumbed to climatic change, many to loss of atmosphere... Not a few worlds were destroyed by the downfall of a satellite.

Stapledon assuaged his gloomy forecasts by setting them in a context of a million worlds and a billion years, in which something like human intelligence appeared a thousand times. Regrettably, we only know one civilization and one form of intelligence: us, the humans on Earth.

After the Cold War the prospects for humanity looked brighter as the threat of nuclear obliteration receded. Francis Fukuyama famously and boldly stated that history had ended, and only advancements

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*Jose A. Tapia is an associate professor in Drexel's Department of Politics. His more popular writings on climate change can be found in a three-part series, "Climate Change: What is to be Done?," published in Brooklyn Rail (brooklynrail.org) on November 2 and December 13, 2017, and February 7, 2018.*

toward the American way of life were to be expected. But only a few years later Fukuyama's idea appeared utterly laughable. The scientific reports on climate change, the increasing rivalry between China and the United States, and the renewed ambitions of Russia, do not seem at all propitious for bright forecasts. Concerning Philadelphia, our city is at a latitude that puts it at a high risk to be in the path of the "tropical storms" that are increasingly frequent in nontropical latitudes. And many parts of the city are just a few feet above sea level.

To be optimistic about 2100 you need to be oblivious to too many realities, including the fact that politicians and businessmen have colluded worldwide to avoid doing anything effective about the destruction of the stability of the climate.

I am pessimistic but I hope I can be wrong. My view is that airplanes and cars are as destructive as nuclear weapons. They are killing us, the human race, no less than smoking two packs of cigarettes a day. We have to try, individually and collectively, to stop using them, the same as we must try to reduce as much as possible our consumption of meat, air conditioning, and disposable products. Recycling does not help. The less energy we use, the better for the future.

I am also skeptical that individual actions will make a difference. We need policies. But perhaps our individual actions will convince other pessimistic people to do the same, out of desperation, and all together demonstrate that we were wrong. History is not written. We are writing it daily.

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