

COOLING INFRASTRUCTURE, COOLING SECURITY, AND A WARMING WORLD

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ABSTRACT—This Essay shows that the climate adaptation challenge for cooling infrastructure—and especially air conditioning—can be thought of as entailing a longer-term challenge and an immediate-term challenge. The longer-term challenge is to spur innovation in air conditioning technology such that new, more environmentally friendly, yet also affordable options become available and adopted. The immediate challenge for cooling infrastructure is to ensure that people right now do not lose their lives and well-being because they lack adequate air conditioning. There are several possible means of meeting the long-term challenge of innovating better, greener, and yet affordable air conditioning, including stricter regulatory requirements, targeted research grants, and innovation prizes. Possible means of meeting the immediate challenge include the use of the federal spending power to incentivize states and localities to use current federal funding streams to better meet household cooling needs, and to take stronger measures, including reformed zoning, to address urban heat island effects. This Essay also underscores the possible national security implications of both the immediate and long-term challenges.

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INTRODUCTION

The world is warming, and to a large extent, further warming is already “baked in.” Even if the nations of the world were to unite in slashing greenhouse gas emissions over the next decades—which is definitely an “if”—the historic store of emissions already in the atmosphere will continue to increase the incidence of a variety of climate-related phenomena, including sea level rise, hurricanes and other storms, drought, and dangerously hot days and heat waves.¹ These phenomena will require people to adapt to warming weather by innovating existing climate control infrastructure.

In this Essay, I focus on what I term “cooling infrastructure,” by which I mean the infrastructure used to (either directly or indirectly) cool indoor environments, so that they are safe and comfortable even in heat wave conditions.² The core of cooling infrastructure, of course, is indoor air conditioning, which can take many forms: two common forms are window air conditioning and central air conditioning. Cooling infrastructure, however, includes other aspects of a building that provide cooling, including

¹ See generally *Impacts of Climate Change*, EPA (Aug. 19, 2022), <https://www.epa.gov/climatechange-science/impacts-climate-change> [https://perma.cc/U3JV-MUKS] (examining the impact of climate change on the environment).

² There has been very limited attention to the topic of heat waves and climate change in legal scholarship. For examples of such scholarship, see Michael B. Gerrard, *Heat Waves: Legal Adaptation to the Most Lethal Climate Disaster (So Far)*, 40 U. ARK. LITTLE ROCK L. REV. 515 (2018) (emphasizing stricter efficiency regulation as a way to address air conditioning’s environmental problems); Cory R. Bernard & Anthony Proano, *Too Hot to Handle: Curbing Mobile Home Heat Deaths in a Warming Climate*, 12 WASH. J. SOC. & ENV’T JUST. 1 (2022) (explaining that assistance programs largely ignore mobile home residents).

building materials and ventilation.³ It also includes outdoor physical conditions that contribute to cooling, such as tree cover and other greenery plantings, light/reflective roofs, and light/reflective/water-absorbing pavement.⁴ Even clothing can be thought of as part of cooling infrastructure.⁵

The cooling infrastructure currently in place in the United States (and elsewhere) was developed for a world before climate change and the increase in intensity and geographic scope of heat waves.⁶ That infrastructure must be adapted to a world where extremely hot days, or even strings of extremely hot days, become the norm rather than exceptional events. Unless the cooling infrastructure embedded in and around our Built Environment is adapted, that Built Environment will not be just uncomfortable, but for many, dangerous. Adaptation in and around the Built Environment is especially important for (but not only for) urban areas that include so-called urban heat islands—densely populated, densely built, and often heavily trafficked areas that can be much warmer than other urban neighborhoods not far away.⁷

As the final section of this Essay argues, meeting the challenges of adapting cooling infrastructure to a warming world is important for U.S.

³ See, e.g., Ricardo Silva et al., *Opportunities for Passive Cooling to Mitigate the Impact of Climate Change in Switzerland*, BLDG. & ENV'T (Nov. 17, 2021), <https://www.sciencedirect.com/science/article/pii/S0360132321009665/pdf> [<https://perma.cc/S29T-Z2X2>] (discussing ventilation and other passive cooling to address climate change); Kay Harrison, *Super Cool Building Materials Prove Powerful Arsenal Against Climate Change*, UNSW NEWSROOM (Oct. 26, 2021), <https://newsroom.unsw.edu.au/news/art-architecture-design/super-cool-building-materials-prove-powerful-arsenal-against-climate> [<https://perma.cc/G26D-ULWV>] (discussing how building materials can be used to address climate change); *5 Ways to Make Buildings Climate Change Resilient*, UNITED NATIONS ENV'T PROGRAMME (July 7, 2021), <https://www.unep.org/news-and-stories/story/5-ways-make-buildings-climate-change-resilient> [<https://perma.cc/DE22-ZZAL>] (discussing building structural design as a way to provide cooling).

⁴ *Cool Roofs*, U.S. DEP'T OF ENERGY, <https://www.energy.gov/energysaver/cool-roofs> [<https://perma.cc/TQW2-9P6S>]; *Using Trees and Vegetation to Reduce Heat Islands*, EPA (Oct. 25, 2022), <https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands> [<https://perma.cc/6UF8-TBDJ>]; *Using Cool Pavements to Reduce Heat Islands*, EPA (Oct. 25, 2022), <https://www.epa.gov/heatislands/using-cool-pavements-reduce-heat-islands> [<https://perma.cc/4YAB-ECCG>].

⁵ Konrad Rykaczewski, *Cool Future Fashion: Personal Cooling as Part of Social Adaptation to Hotter Climates*, 6 TEMPERATURE 97, 97–99 (2019), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6601410> [<https://perma.cc/9SB6-LYD5>].

⁶ See Jacopo Prisco, *Why It's Time to Redesign the Old Air Conditioner*, CNN (Dec. 2, 2019), <https://www.cnn.com/style/article/global-cooling-prize-india/index.html> [<https://perma.cc/G9NN-32L4>] (explaining that “[t]he air conditioner is nearly 100 years old, and yet it hasn’t evolved much—the technology is essentially the same as it was the day it was invented.”).

⁷ *Heat Island Effect*, EPA (Jan. 13, 2023), <https://www.epa.gov/heatislands> [<https://perma.cc/2EYM-RCC5>]; Ashley R. Williams, *Urban Heat Islands Are Why It Can Feel 20 Degrees Hotter in Different Parts of the Same City*, USA TODAY (July 23, 2022, 6:00 AM), <https://www.usatoday.com/story/news/nation/2022/07/23/urban-heat-island-city-what-to-know/10002066002/?gnt-cfr=1> [<https://perma.cc/W39B-RBDN>].

national security, among other goals. There is substantial literature on “food security” and “water security,” explaining how the lack of food and water in a warming world can lead to political and social instability throughout the world, and by extension, implicate U.S. national security.⁸ “Cooling security”—a term that is not in the legal or policy lexicon, but I am positing here should be—also matters; if people cannot access cooling in an affordable way, they will be forced to fight over resources (such as electricity) or even flee their current homes. Like lack of food and water security, lack of cooling security can lead to political and social instability in regions of the world important for U.S. national security.⁹

Moreover, adapting cooling infrastructure to make it accessible and environmentally sustainable throughout the world is important because, otherwise, we will be unable to achieve even modest global goals of reducing fossil fuel consumption. Under that scenario, climate change will continue to be exacerbated, and so too will *all* the various national security challenges linked to climate change.¹⁰

Finally, U.S. international standing, and hence national security, relies partly on the “soft power”¹¹ of being seen as a model for other nations and as a sincere proponent of humanitarian ideals that actually lives up to those ideals within its own borders. U.S. soft power takes a “hit,” as it were, when there are news stories of low-income and other vulnerable Americans literally dying from heat in the United States, just as it takes a hit when there are news stories of low-income households in U.S. cities lacking potable water or otherwise suffering from glaring inequalities.¹²

⁸ See, e.g., Carolyn Kenney, *How Climate Change and Water and Food Insecurity Drive Instability*, CTR. FOR AM. PROGRESS (Nov. 30, 2017), <https://www.americanprogress.org/article/climate-change-water-food-insecurity-drive-instability/> [<https://perma.cc/P99A-CYFV>] (discussing the increased risk of political instability and conflict posed by depleting water and food supplies as a result of climate change).

⁹ See Dan De Luce, *Climate Change Threatens to Spark Instability, Conflict Around the World*, U.S. Intelligence Agencies Warn, NBC NEWS (Oct. 21, 2021, 1:55 PM), <https://www.nbcnews.com/politics/national-security/climate-change-threatens-spark-instability-conflict-around-world-u-s-n1282078> [<https://perma.cc/5RB6-EUDN>] (reporting on a National Intelligence Estimate addressing how climate change will fuel global tensions); see also *infra* Part IV.

¹⁰ See *infra* Part IV.

¹¹ On the concept of soft power, as articulated by the eminent political scientist Joseph Nye, see Joseph S. Nye Jr., *American Democracy and Soft Power*, PROJECT SYNDICATE (Nov. 21, 2021), <https://www.project-syndicate.org/commentary/american-democracy-and-soft-power-by-joseph-s-nye-2021-11> [<https://perma.cc/6B9T-7X83>].

¹² See, e.g., Kurt M. Campbell, *How Income Inequality Undermines U.S. Power*, WASH. POST (Nov. 28, 2014), https://www.washingtonpost.com/opinions/how-income-inequality-undermines-us-power/2014/11/28/53fab4e4-74e5-11e4-9d9b-86d397daad27_story.html [<https://perma.cc/KB3X-UU86>] (discussing how reports of income inequality can affect the role of the U.S. in the world); Carol Graham, *America's Broken Dream*, PROJECT SYNDICATE (Sept. 5, 2013), <https://www.project-syndicate.org/commentary/the-global-impact-of-rising-inequality-in-the-us-by-carol-graham?barrier>

Parts II and III of this Essay show that the adaptation challenge for cooling infrastructure—and especially air conditioning—can be thought of as entailing a long (or longer)-term challenge and an immediate-term challenge. The longer-term challenge is to spur innovation in air conditioning technology such that new, more environmentally friendly, yet also affordable options become available and adopted over the next decade or two throughout the world. Air conditioning traditionally produces substantial greenhouse gas emissions, both because it burns fossil fuels to provide the electricity that powers the air conditioning and because air conditioning usually uses certain refrigerants that are also warming the atmosphere.¹³ There is, thus, a need to incentivize the development of cooling technologies that require less energy (or at least less fossil fuel-based energy) and also less or no refrigerants that themselves harm the atmosphere. But efficiency in terms of climate impact is only one consideration regarding innovation—affordability also matters a great deal. In order for very “green” air conditioning to prevail in the marketplace throughout the world, even with government subsidies, it will need to be somewhat cost competitive; it cannot cost much more than the older, environmentally harmful, readily available technologies.¹⁴

The immediate challenge for cooling infrastructure is to ensure that people right now do not lose their lives and well-being because they lack any air conditioning or only have grossly inadequate air conditioning. In the United States, the most vulnerable populations—low-income tenants, disabled people, and elderly people—face the greatest risk of death or illness from lack of air conditioning.¹⁵ These people cannot—and should not—be required to wait for technological innovation. The challenge is essentially one of law and governance: how can law and policy ensure vulnerable populations be afforded adequate, reasonably efficient air conditioning that they will have the resources to operate when weather conditions require?

Legal mandates on landlords can help mitigate the immediate challenges of cooling infrastructure but at the same time, we know that

=accesspaylog [https://perma.cc/4UQ9-ED6Z] (“Given increasing evidence that the system is performing much better for wealthier citizens than for poorer ones, America’s soft power seems bound to erode substantially.”); *see also infra* Part IV.

¹³ Umair Irfan, *The Air Conditioning Paradox*, VOX (May 18, 2022, 7:30 AM), <https://www.vox.com/science-and-health/23067049/heat-wave-air-conditioning-cooling-india-climate-change> [https://perma.cc/M29H-FNMU].

¹⁴ *See* Katherine White et al., *The Elusive Green Consumer*, 97 HARV. BUS. REV. 124 (2019) (explaining that although consumers have “green” attitudes, those attitudes do not drive their buying choices as consumers).

¹⁵ The scope of this Essay is limited: I do not address the difficult questions raised by extreme heat outside of homes—in the workplace, in school, in public facilities, among others. *See infra* Section I.A.

requirements for rental housing conditions, especially in the low-income setting, often go unenforced.¹⁶ Moreover, when they are enforced, mandates can increase the cost and decrease the availability of (already in short supply) low-income housing.¹⁷ For that and other reasons, mandates almost certainly need to be coupled with subsidies to both landlords of very low-income tenants and low-income tenants and owners, as well direct government installation of air conditioning for those most in need. This may require an adjustment in the federal government's posture toward states with regard to subsidy programs. Rather than giving states wide leeway to determine if cooling (and, more than that, efficient cooling) is included and prioritized in state implementation of federally funded subsidy programs, the federal government will need to require that states do so as a condition of funding.

Part of the immediate challenge for cooling infrastructure is also to address—and mitigate—the conditions that contribute to heat islands. This will be all the more important once access to air conditioning in low-income areas is expanded because air conditioning itself can contribute to the heat island effect by releasing hot air into the surrounding outdoors.¹⁸ As with subsidies to property owners and tenants, one of the biggest questions is what will be the role of the federal government vis-à-vis states and localities. The conditions that create heat islands are closely tied in with land use and zoning decisions and other decisions typically left to local governments.¹⁹ But localities on their own may lack the knowledge, funding, and political will to tackle the conditions that contribute to heat islands. At a minimum, the federal government needs to play an active role in coordinating and facilitating funding, assessing the heat islands throughout the country, facilitating the sharing of information about best practices to mitigate the urban heat island effect, and urging localities to try different approaches. If there is a need, and there may well be, the federal government should condition federal funding on a state and its localities' undertaking of reasonable efforts to mitigate heat island effects in all neighborhoods and

¹⁶ See generally Kathryn A. Sabbeth, *(Under)Enforcement of Poor Tenants' Rights*, 27 GEO. J. ON POVERTY L. & POL'Y 97 (2019) (analyzing nonenforcement and underenforcement of landlord mandates).

¹⁷ Robin Bartram, *The Cost of Code Violations: How Building Codes Shape Residential Sales Prices and Rents*, 29 HOUS. POL'Y DEBATE 931 (2019) (explaining that code enforcement does tend to increase rents, but also explaining that the relationship between regulation and rents and sales prices is complicated).

¹⁸ See Irfan, *supra* note 13 ("It's also a law of nature that you can't cool a space without heating up another. In cities, the heat from running ACs at night can raise ambient temperatures by 1°C, or 1.8°F.")

¹⁹ See generally SARA P. HOVERTER, GEORGETOWN CLIMATE CTR., ADAPTING TO URBAN HEAT: A TOOL KIT FOR LOCAL GOVERNMENTS (2012) (exploring how local governments can mitigate heat island effects).

communities that are in need, even those that for whatever reasons lack political salience for state and local elected officials.

To the extent cooling infrastructure thus necessitates federal funding to innovative researchers, landlords of low-income tenants, low-income owners, low-income tenants, and states and localities, it will be very important to verify and publicize that the money is well spent. In the United States, at least, trust in government is near an all-time low,²⁰ and climate is such a politicized issue that any “free lunches” associated with climate effects are apt to be questioned and even mocked.²¹ Thus, these government funding programs require careful design and oversight. This is especially true when—as may occur in the wake of the passage of the Inflation Reduction Act²² and the sudden availability of billions in funding—there may be an excited rush to seek and disburse a new source of funds.

In a warming climate, the world needs more efficient and affordable cooling infrastructure. Part I describes the phenomena of increasing heat and heat waves and their health and social effects, focusing on heat islands in the United States; surveys what we know about the unmet need for air conditioning in the United States; and discusses the environmental problems with air conditioning that impact the globe. Part II considers several possible means of meeting the long-term challenge of innovating better, greener, and yet affordable air conditioning: (1) stricter regulatory requirements, (2) targeted research grants, and (3) innovation prizes. Part III considers different possible means to address the immediate challenges regarding cooling infrastructure—the pressing problem of low-income households without air conditioning or means to run air conditioning and the need to enhance and ensure equity in government efforts to lessen heat island effects. Finally, Part IV underscores the national security implications of both the immediate and long-term challenges. Ultimately, taking on both challenges is necessary for U.S. national security.

²⁰ Maureen Breslin, *Trust in Government Near All-Time Low: Poll*, THE HILL (June 7, 2022, 8:23 AM), <https://thehill.com/blogs/blog-briefing-room/news/3514131-trust-in-government-near-all-time-low-poll/> [<https://perma.cc/6LTT-QAKK>].

²¹ See Rachel Hawes & Matthew C. Nowlin, *Climate Science or Politics? Disentangling the Roles of Citizen Beliefs and Support for Energy in the United States*, ENERGY RSCH. & SOC. SCI. (Nov. 27, 2021).

²² Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1818 (2022) (establishing a variety of funding and tax credit programs to transition the economy toward cleaner energy sources); see also Vanessa Glavinskas, *The Inflation Reduction Act Is a Victory for the Climate. Here's What Comes Next*, ENV'T DEF. FUND (Sept. 6, 2022), <https://www.edf.org/article/inflation-reduction-act-victory-climate-heres-what-comes-next> [<https://perma.cc/Z6YY-9CRA>] (describing how the Act provides over \$369 billion in climate funding).

I. THE UNMET NEED FOR AIR CONDITIONING AND AIR CONDITIONING'S ENVIRONMENTAL PROBLEMS

While the lack of indoor cooling is a global problem in a warming world, this Part focuses on the United States, in part because the unmet needs for cooling vary greatly across the planet. The environmental issues with conventional air conditioning, however, are global because the negative impacts affect the atmosphere as a whole. An increase in air conditioning in the United States or China, thus, will affect everyone on the planet.

A. *Heat Waves, Heat Islands, And Gaps In Air Conditioning*

The intensification of extreme heat and heat waves has begun and will continue as a result of anthropogenic climate change.²³ According to IPCC, “[c]limate changes related to warming temperature, including more

intense heatwaves over land and in the ocean . . . are projected with high confidence”²⁴ As the IPCC notes, in North America, there is already evidence of “increases in the intensity and frequency of hot extremes, such as warm days, warm nights, and heatwaves”²⁵ Indeed, the EPA has documented that the frequency and intensity of heat waves have climbed steadily from the 1960s through the 2010s.²⁶ The most dramatic heat wave disaster to date in the United States occurred in Chicago, where over 700 people died from heat-related causes in 1995.²⁷ But without adaptation, heat disasters could occur far to the north of Chicago by 2050, as the heat wave belt shifts to more and more parts of North America.²⁸

The summer of 2022 is illustrative of this warming phenomenon. For example, “San Antonio has seen at least 46 days of 100-plus-degree weather so far this year Through July 25, measurements taken at the city’s airport have detected that all but one day in July has surpassed the 100-degree

²³ See Quirin Schiermeier, *Climate Change Made North America’s Deadly Heatwave 150 Times More Likely*, NATURE (July 8, 2021), <https://www.nature.com/articles/d41586-021-01869-0> [<https://perma.cc/4458-MHX9>] (explaining expert conclusions that recent heat waves could not be accounted for absent anthropogenic climate change).

²⁴ Hicke, J.A. et al., *North America*, in CLIMATE CHANGE 2022: IMPACTS, ADAPTATION AND VULNERABILITY 1937 (2022).

²⁵ Rajib Shaw et al., *Asia*, in CLIMATE CHANGE 2022: IMPACTS ADAPTATION AND VULNERABILITY, *supra* note 24, at 1556.

²⁶ *Climate Change Indicators: Heat Waves*, EPA (Aug. 1, 2022), <https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves> [<https://perma.cc/8AJB-4735>].

²⁷ Nicholas Rajkovich, *Cities Need More Than Air Conditioning to Get Through Heat Waves*, THE CONVERSATION (July 31, 2018, 9:48 AM), <https://theconversation.com/cities-need-more-than-air-conditioning-to-get-through-heat-waves-81069> [<https://perma.cc/D3AB-DWDS>].

²⁸ Leslie Kaufman, *Much of the US Will Be an ‘Extreme Heat Belt’ by the 2050s*, BLOOMBERG (Aug. 14, 2022, 11:01 PM), <https://www.bloomberg.com/news/articles/2022-08-15/us-south-midwest-will-reach-temps-of-125-f-by-2050s> [<https://perma.cc/Y2GT-QSV3>].

mark.”²⁹ According to Zack Taylor of the National Meteorological Service, “back-to-back heat waves are becoming a concern.”³⁰ Taylor explains that “[t]hese multiday heat waves can become more dangerous, because the body is unable to cool off at night And it’s just repeating, day after day after day of high heat and humidity.”³¹

The costs of extreme heat are high. As EPA explains, “[h]eat waves are more than just uncomfortable: they can lead to illness and death, particularly among older adults, the very young, and other vulnerable populations”³² As one expert summarized, “[h]eat is climate change at its most devastatingly intimate, ravaging not just landscapes and ecosystems and infrastructure, but the depths of individual human bodies.”³³ Extreme heat clearly impacts not just physical health but also mental health, especially among vulnerable populations.³⁴ The economic costs of extreme heat, which lessens the ability of people to work or work productively, are also estimated to be very high.³⁵ People with a range of disabilities—including the disabled elderly—suffer disproportionately from heat waves.³⁶

The effects of heat waves are accentuated in so-called heat islands. Heat islands are defined by EPA as:

Heat islands are urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun’s heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become “islands” of higher temperatures relative to outlying areas. Daytime temperatures in urban areas

²⁹ Edgar Sandoval, *In San Antonio, the Poor Live on Their Own Islands of Heat*, N.Y. TIMES (July 26, 2022), <https://www.nytimes.com/2022/07/26/us/texas-heat-poverty-islands-san-antonio.html> [<https://perma.cc/YM34-MPZP>].

³⁰ Isabella Grullón Paz, *70 Million Americans Are Under Heat Warnings or Advisories*, N.Y. TIMES (July 8, 2022), <https://www.nytimes.com/2022/07/06/us/heat-midwest-forecast-temperatures.html> [<https://perma.cc/5U36-VGWN>] (quoting Zack Taylor of the National Meteorological Service).

³¹ *Id.*

³² *Climate Change Indicators: Heat Waves*, *supra* note 26.

³³ Raymond Zhong, *How Extreme Heat Kills, Sickens, Strains and Ages Us*, N.Y. TIMES (July 19, 2022), <https://www.nytimes.com/2022/06/13/climate/extreme-heat-wave-health.html> [<https://perma.cc/62CS-LKNE>].

³⁴ *Extreme Heat Contributes to Worsening Mental Health, Especially Among Vulnerable Populations*, AM. PSYCHIATRIC ASS’N (June 30, 2021), <https://psychiatry.org/news-room/news-releases/extreme-heat-contributes-to-worsening-mental-health> [<https://perma.cc/BT2N-5RFL>].

³⁵ Kathy Baughman McLeod, *Heat Is Killing Us—and the Economy Too*, ATLANTIC COUNCIL (Sept. 7, 2021), <https://www.atlanticcouncil.org/content-series/the-big-story/heat-is-killing-us-and-the-economy-too> [<https://perma.cc/24EV-J25Q>].

³⁶ Kiara Alfonseca, *How Heat Waves, Climate Change Put People with Disabilities at Risk*, ABC NEWS (July 8, 2021, 6:00 AM), <https://abcnews.go.com/Health/heat-waves-climate-change-put-people-disabilities-risk/story?id=78689514> [<https://perma.cc/V7HB-L8P7>].

are about 1–7°F higher than temperatures in outlying areas and nighttime temperatures are about 2–5°F higher.³⁷

Heat islands are often in low-income, Black or Latino neighborhoods, as well as in Native American and Indigenous communities.³⁸ As a recent study concluded, “[l]ow-income neighborhoods and communities with higher Black, Hispanic and Asian populations experience significantly more urban heat than wealthier and predominantly white neighborhoods within a vast majority of populous U.S. counties”³⁹ For example, the low-income Latino neighborhood of Westdale in San Antonio is much hotter than nearby areas because of “the high ratio of asphalt to green space — along with old structures, freight trains and an abundance of concrete”⁴⁰ While urban heat islands are found throughout the United States, “[c]ities in the Midwest and Northeast, such as New York, Newark, Boston, Chicago, Providence, Detroit, and Cleveland have more compact, historically built-out environments, with taller buildings,” and “[t]hese factors add to the intensity of their urban heat island footprint.”⁴¹

While most Americans do have access to air conditioning in their residences, some of those who are most in need of cooling lack any air conditioning. According to a recent study, about 10% of Americans have no air conditioning, and even in extraordinarily hot localities such as Phoenix, there are some, although relatively fewer, homes without any air conditioning.⁴² As one might suppose, hotter cities have lower percentages of unair-conditioned homes, but weather alone is not the only determinant: for example, “Ohio, Cincinnati, and Cleveland have similar summer climates, but three times as many households in Cleveland—a substantially poorer metro area—have no AC.”⁴³ As a general matter, throughout the

³⁷ *Heat Island Effect*, EPA (Jan. 13, 2023), <https://www.epa.gov/heatislands> [<https://perma.cc/JYQ2-LJHB>].

³⁸ Kaitlin Sullivan, *Black, Latino, and Indigenous Communities Hit Hardest by Heat Waves*, EVERYDAY HEALTH (Oct. 8, 2020), <https://www.everydayhealth.com/healthy-living/black-latinx-and-indigenous-communities-hit-hardest-by-heat-waves> [<https://perma.cc/8NSP-74CA>].

³⁹ Christine Clark, *Poor and Minority Communities Suffer More from Extreme Heat in U.S. Cities*, UC SAN DIEGO TODAY (July 13, 2021), <https://ucsdnews.ucsd.edu/pressrelease/poor-and-minority-communities-suffer-more-from-extreme-heat-in-u.s-cities> [<https://perma.cc/3C5H-7DBL>].

⁴⁰ See Sandoval, *supra* note 29.

⁴¹ *Boston on List of Cities with Worst Urban Heat, Where Temperatures Can Spike 15–20 Degrees in a Matter of Blocks*, CBS NEWS (July 15, 2021, 12:26 PM), <https://www.cbsnews.com/boston/news/urban-heat-islands-cities-list-boston-climate-central> [<https://perma.cc/W25C-Y3VR>].

⁴² Rebecca Mann & Jenny Schuetz, *As Extreme Heat Grips the Globe, Access to Air Conditioning Is an Urgent Public Health Issue*, BROOKINGS (July 25, 2022), <https://www.brookings.edu/blog/the-avenue/2022/07/25/as-extreme-heat-grips-the-globe-access-to-air-conditioning-is-an-urgent-public-health-issue> [<https://perma.cc/C2D8-4HZ9>].

⁴³ *Id.*

country, it is the poorest households that are most likely to lack air conditioning: in 35 metro areas, 12% of households in the lowest income quartile lack any air conditioning.⁴⁴ Renters are much more likely than owners to lack any air conditioning.⁴⁵ “In metro areas where a substantial number of homes lack air conditioning, there are pronounced racial gaps, with Black and Latino or Hispanic households being less likely to have air conditioning.”⁴⁶

Moreover, even when low-income renters and owners do have air conditioning, they often are unable to afford to run it when they need it—during periods of intense, prolonged heat. Many leases allocate tenants full responsibility for electric bills. Anecdotal accounts abound of low-income residents who simply cannot afford to run their conditioning even on the hottest days and even when they are vulnerable due to medical conditions.⁴⁷

B. *The Environmental Problems With Air Conditioning*

Even though there is a dire need for air conditioning on a warming planet, there are three distinct, climate-change-related problems with air conditioning. First, and most obviously, air conditioning traditionally is powered by electricity, and electricity most often is generated by fossil fuel combustion that emits greenhouse gases, notably carbon dioxide. Researchers calculate that air conditioning is now “responsible for the equivalent of 1,950 million tons of carbon dioxide released annually, or 3.94% of global greenhouse gas emissions.”⁴⁸ The vast expansion of air conditioning that will almost certainly occur as the world warms, including in countries such as China and India with enormous populations and growing middle classes,⁴⁹ is often invoked as one reason that emissions reductions goals may never be met:

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ *Id.*

⁴⁷ Tami Luhby, *Not Everyone Can Afford Air Conditioning During a Brutal Heat Wave. Here’s How They Cope*, CNN (July 19, 2022, 2:38 PM), <https://www.cnn.com/2022/07/19/economy/air-conditioning-electric-bills-heat-wave/index.html> [<https://perma.cc/945G-XGWR>]; Mark Wolfe, *America’s Most Vulnerable Suffer Without AC During Heat Waves*, CNN (July 6, 2021, 9:07 AM), <https://www.cnn.com/2021/07/04/perspectives/heat-waves-low-income-americans/index.html> [<https://perma.cc/PJQ3-77FT>]; Suzy Khimm & Joshua Eaton, *As Deadly Heat Waves Spread, Access to Air Conditioning Becomes a Lifesaving Question*, NBC NEWS (Aug. 20, 2021, 4:31 AM), <https://www.nbcnews.com/news/us-news/deadly-heat-waves-spread-access-air-conditioning-becomes-lifesaving-question-n1277213> [<https://perma.cc/QGC5-HBGZ>].

⁴⁸ *Scientists Show Large Impact of Controlling Humidity on Greenhouse Gas Emissions*, NAT’L RENEWABLE ENERGY LAB’Y (Mar. 14, 2022), <https://www.nrel.gov/news/press/2022/nrel-shows-impact-of-controlling-humidity-on-greenhouse-gas-emissions.html> [<https://perma.cc/NV29-HFJV>].

⁴⁹ See Irfan, *supra* note 13 (“There are billions of people that aspire to be wealthy, and as your income starts going up, you’re going to want to have access to cooling.”).

By 2050, researchers expect the number of room air conditioners on Earth to quadruple to 4.5 billion, becoming at least as ubiquitous as cell phones are today. By the end of the century, greenhouse gas emissions from air conditioning will account for as much as a 0.5-degree Celsius rise in global temperatures, according to calculations by the World Economic Forum.⁵⁰

Second, greenhouse gas emissions from air conditioning come not just from the electricity that powers air conditioning technology but also from the refrigerants that are used as part of the cooling process. Indeed, the most common refrigerant used in air conditioning is a much more potent greenhouse gas than carbon dioxide: “[m]ost air conditioners and heat pumps in the United States today rely on HFC-410a, a chemical refrigerant that is 4,260 times as potent as carbon dioxide at warming the atmosphere over a 20-year period.”⁵¹ According to one commentator, “the air conditioning sector, needs to transition away from HFCs if we are to even keep the hope alive of staying within a 1.5 degree Celsius warming world.”⁵²

A third environmental problem with air conditioning is more localized: most air conditioning systems draw heat and vapor out of the indoor environment and release it outdoors.⁵³ As a result, air conditioning heats the outdoor areas where it has been installed.⁵⁴ More air conditioning in heat islands, therefore, could itself exacerbate the heat island effect, leading to less healthful outdoor conditions and the need for even more indoor air conditioning. There do not seem to be very good estimates of how much air conditioning in heat islands contributes or would contribute to exacerbating the heat island effect.⁵⁵ But, it is clear that adding air conditioning to existing heat islands makes the islands hotter.

⁵⁰ Emily Underwood, *How to Prevent Air Conditioners from Heating the Planet*, SCI. AM. (June 23, 2021), <https://www.scientificamerican.com/article/how-to-prevent-air-conditioners-from-heating-the-planet> [https://perma.cc/89N7-BN8E].

⁵¹ Phil McKenna, *International Commission Votes to Allow Use of More Climate-Friendly Refrigerants in AC and Heat Pumps*, INSIDE CLIMATE NEWS (May 22, 2022), <https://insideclimatenews.org/news/22052022/climate-refrigerants-air-conditioning-heat-pumps> [https://perma.cc/BW4T-DMNN].

⁵² *Id.* Yet another issue with some refrigerants still in use in equipment and systems, distinct from global warming impact, is that they deplete the ozone layer. See *Refrigeration and Air Conditioning*, UNITED NATIONS ENV’T PROGRAMME, <https://www.unep.org/ozonaction/what-we-do/refrigeration-and-air-conditioning> [https://perma.cc/PYQ6-NFDW].

⁵³ See, e.g., Irfan, *supra* note 13 (explaining that air conditioning increases outdoor ambient temperatures in cities).

⁵⁴ *Id.*

⁵⁵ There has been some modeling to address this question in particular urban settings. See, e.g., Cécile de Munck et al., *How Much Can Air Conditioning Increase Air Temperatures for a City Like Paris, France?*, 33 INT’L J. CLIMATOLOGY 210 (2013), https://www.researchgate.net/publication/256756336_

In sum, while the demand for air conditioning will continue to increase, it is being denied to some Americans who very much need it now. At the same time, air conditioning is a highly problematic technology in its current form, adding to greenhouse gases both via power generation and refrigerant release, as well as by contributing to localized heat islands. Given this, there are two challenges for policymakers—first, the challenge to transform air conditioning into a greener technology that is affordable enough to be widely adopted over time, and, second, the more immediate challenge of alleviating the suffering of those who are exposed to dangerous levels of heat right now. These two different challenges call for different sorts of legal and policy interventions.

II. THE LONG-TERM INNOVATION CHALLENGE

Air conditioning, in its current form, employs basically the same technology as it did over a century ago when it was first invented.⁵⁶ As one commentator explained, “[t]he basic cooling technology behind air conditioning and refrigerators hasn’t changed significantly since 1902 when a young American engineer named Willis Carrier devised the first air conditioner to solve a humidity problem for a printing company in New York City.”⁵⁷ Although air conditioners have become more energy efficient in the last century, even energy efficiency has not improved much in the last decade; “AC units are only 10 percent more efficient than those sold in 2010.”⁵⁸

Air conditioning is thus long overdue for an “upgrade.”⁵⁹ Most of the focus of the industry has been to lower costs but not to improve environmental performance.⁶⁰ A recent UN report, “Chilling Prospects:

How_much_air_conditioning_can_increase_air_temperatures_for_a_city_like_Paris_France [https://perma.cc/H3LS-R2XK].

⁵⁶ Rebecca Heilweil, *The Search for an AC That Doesn’t Destroy the Planet*, VOX (Aug. 10, 2022, 1:30 PM), <https://www.vox.com/recode/2022/8/10/23300032/air-conditioner-planet-climate-change-heat-pumps> [https://perma.cc/Z5S4-AXDC]; Underwood, *supra* note 50.

⁵⁷ Underwood, *supra* note 50.

⁵⁸ Rose M. Mutiso et al., *Air-Conditioning Should Be a Human Right in the Climate Crisis*, SCI. AM. (May 10, 2022), <https://www.scientificamerican.com/article/air-conditioning-should-be-a-human-right-in-the-climate-crisis/> [https://perma.cc/X4KG-FEJR] (“According to the IEA, today’s average AC units are only 10 percent more efficient than those sold in 2010—but effective policy and technology can double the efficiency of AC units and reduce cooling energy demand by 45 percent by 2050. To drive up efficiency, the practice of dumping older—and thus less efficient and more environmentally harmful—models in poor countries should be restricted. In addition to setting efficiency standards, governments (along with philanthropic organizations and manufacturers) must invest in driving down the cost of higher-quality air conditioner models.”).

⁵⁹ See Mann & Schuetz *supra* note 42; see also Underwood, *supra* note 50.

⁶⁰ Prisco, *supra* note 6.

Providing Sustainable Cooling for All,” urges the industry to speed up “their innovation efforts and think more holistically about the way we provide cooling, focusing firstly on reducing heat loads and then thinking about how to deliver remaining cooling as affordably and sustainably as possible.”⁶¹ The report’s lead author explains:

We’re calling on business and other private sector entities to provide those solutions. These groups have to come together as a matter of priority to provide low Global Warming Potential (GWP) technology and business models that are affordable and sustainable, and that address the needs of the poor and vulnerable populations most at risk, so no one has to make a choice between cooling and achievement of the Sustainable Development Goals and Paris Climate objectives.⁶²

The innovation challenge for air conditioning, especially on the global scale, is complex. Innovators ideally would maximize three goals (energy efficiency, reduction of harmful refrigerants, affordability) at the same time.⁶³ But there are inherent tensions or trade-offs among these goals. On the one hand, there is a need to produce cooling that uses less (or no) fossil-fuel-generated power, but doing so may be more difficult if all or almost all environmentally problematic refrigerants must be foregone. And, achieving the objectives of low-energy consumption and no problematic refrigerants may be in tension with the affordability goal. It is difficult, *ex ante*, to say what the optimal mix of the three metrics should be, and indeed, there may be no single optimal mix, but rather different mixes that are appropriate for different settings across the globe. As one commentator explains:

There is no single perfect refrigerant for diverse air conditioning, refrigeration, and industrial applications. The predominant halocarbons (CFCs, HCFCs, and HFCs) combine excellent efficiency and safety with acceptable costs. However, they contribute to ozone depletion potential (ODP) and/or global warming potential (GWP) All [potential options] involve significant trade-offs among GWP, energy efficiency, safety, and cost. Environmental policy must consider the indirect effects of increased

⁶¹ Thalif Deen, *Amidst Rising Heat Waves, UN Says Cooling is a Human Right, Not a Luxury*, INTER PRESS SERV. (Aug. 6, 2018), <https://www.ipsnews.net/2018/08/amidst-rising-heat-waves-un-says-cooling-human-right-not-luxury/> [<https://perma.cc/PWE8-SZR3>].

⁶² *Id.*

⁶³ See, e.g., Rose M. Mutiso et al., *Air-Conditioning Should Be a Human Right in the Climate Crisis*, SCI. AM. (May 10, 2022), <https://www.scientificamerican.com/article/air-conditioning-should-be-a-human-right-in-the-climate-crisis/> [<https://perma.cc/9JDA-Q5MR>] (“Manufacturers and governments must also innovate to develop affordable and efficient AC technology using refrigerants with lower climate impact.”).

CO₂ emissions for less efficient refrigerants, not just the direct global warming (GWP) of the refrigerant.⁶⁴

A variety of criteria must be weighed in the transformation of air conditioning technology, which makes traditional regulatory and taxing tools imperfect (or at least incomplete) as spurs to innovation. One could imagine a tax that would promote air conditioning with lesser global warming, but the tax would need to encompass not just carbon dioxide but also refrigerant-related gases. Moreover, the tax would reduce the affordability of air conditioning (hence adding to the problem of people without adequate cooling now), and might not result in greener solutions that would be affordable for less wealthy countries and low-income people in wealthy countries. In addition, as is clear, a domestic or international greenhouse gas tax seems nowhere near on the political horizon.⁶⁵

As to prescriptive regulation, even if regulators could and wanted to adopt prescriptive regulations with the explicit aim of promoting the various (and potentially conflicting) goals of cooling innovation, it is far from obvious that they would know how to do so in practice. Again, air conditioning technology, in its basic form, is quite old; genuine innovation, and not just refinement of existing practices, is needed. How could regulators know how to direct genuine innovation of the parameters which they do not know and perhaps (understandably) cannot even imagine?⁶⁶

Another problem with a regulatory approach is that, at least so far, actual regulation in the domain of cooling has been slow and modest, no doubt reflecting the power of existing industry players and broader concerns about any economic dislocation from the imposition of new regulatory costs. It is true that the U.S. Department of Energy has promulgated new efficiency standards for air conditioning and heat pump units and systems, which became effective in January 2023.⁶⁷ However, the political difficulty of using

⁶⁴ HUNG PHAM & HARVEY SACHS, *Next Generation Refrigerants: Standards and Climate Policy Implications of Engineering Constraints*, in 2010 ACEEE SUMMER STUDY ON ENERGY EFFICIENCY IN BUILDINGS, at 1-282 (2010).

⁶⁵ See Paul Krugman, *Why We Don't Have a Carbon Tax*, N.Y. TIMES (Aug. 16, 2022), <https://www.nytimes.com/2022/08/16/opinion/carbon-tax.html> [<https://perma.cc/YJ3W-XTCC>]; Scott Sumner, *The Politics of Carbon Taxes Versus Clean Energy Subsidies*, THE HILL (Nov. 25, 2021, 12:00 PM), <https://thehill.com/opinion/energy-environment/583125-the-politics-of-carbon-taxes-versus-clean-energy-subsidies/> [<https://perma.cc/ZE5K-AQDU>].

⁶⁶ Air conditioning thus entails a common problem with regulation of new or undiscovered technologies: how can one regulate what one does not already understand? On this problem in the context of nanotechnology, see DAVID A. DANA, *Toward Risk-Based, Adaptive Regulatory Definitions*, in THE NANOTECHNOLOGY CHALLENGE: CREATING LEGAL INSTITUTIONS FOR UNCERTAIN RISKS 105–16 (David A. Dana ed., 2011).

⁶⁷ Energy Conservation Program: Test Procedure for Central Air Conditioners and Heat Pumps, 87 Fed. Reg. 64550, 64550 (Oct. 25, 2022); Vladimir Kochkin, *Upcoming Changes to Efficiency*

regulation to push innovation is underscored by the fact that these regulations are the first since 2015 to increase efficiency requirements, and by the fact that they do not seem to require builders to use any technology that has not already been widely available for a long time.⁶⁸ Moreover, the new regulations only address energy efficiency and no other criteria such as costs or use of refrigerants, and they do not address at all the problem of the need to upgrade low-efficiency units already in use.⁶⁹

The pattern of regulation with respect to refrigerants also suggests the difficulty of regulation as a driver of innovation. EPA promulgated rules in 2015 and 2016 designed to phase out “the use of refrigerants with high global warming potential (GWP), but those rules were vacated by the D.C. Circuit Court in 2017 and 2019.”⁷⁰ Since then, there has been a patchwork of state regulations targeting the same high-GWP refrigerants as the vacated rules, but the state regulations have “different effective dates and even define the effective dates differently”; and many major States—including Texas and Florida—have no regulations at all.⁷¹ In 2022, the Senate finally ratified the 2016 Kigali Amendment to the Montreal Protocol, which calls for the phasing out of HFCs.⁷² But the Kigali Amendment itself provides nations several decades to achieve the phaseout, and the ultimate phaseout is not a total one.⁷³ And as with any international accord, actual compliance and enforcement is ultimately the domain of each signatory nation.

Standards for AC Units and Heat Pumps, NAT’L ASS’N OF HOME BUILDERS (May 25, 2022), <https://www.nahb.org/blog/2022/05/upcoming-changes-efficiency-standards-ac-units-heat-pumps> [<https://perma.cc/K8QK-FTJ5>].

⁶⁸ See Kochkin, *supra* note 67.

⁶⁹ See *id.*; Olivia Clark & Kevin Jarzowski, *Efficiency Requirements for Residential Central AC and Heat Pumps to Rise in 2023*, U.S. ENERGY INFO. ADMIN. (July 30, 2019), <https://www.eia.gov/todayinenergy/detail.php?id=40232> [<https://perma.cc/ZW9D-5T8X>]; Karl Pomeroy, *2023 HVAC Regulation Changes: What Can Companies Do to Prepare?*, FORBES (Mar. 21, 2022, 10:15 AM), <https://www.forbes.com/sites/forbesbusinesscouncil/2022/03/21/2023-hvac-regulation-changes-what-can-companies-do-to-prepare/?sh=6d2975cb3151> [<https://perma.cc/ZH7X-2SHZ>] (predicting that the new regulations will lead to cost increase).

⁷⁰ *An Update on Refrigerant Regulations (2020-2022)*, ZERO ZONE, INC., <https://www.zero-zone.com/refrigerant-regulations-update-2020-1/> [<https://perma.cc/9PR6-W9YU>].

⁷¹ *Id.*

⁷² *Chairman Menendez Celebrates SFRC Approval of Kigali Amendment*, FOREIGN REL. COMM. (May 4, 2022), <https://www.foreign.senate.gov/press/dem/release/chairman-menendez-celebrates-sfrc-approval-of-kigali-amendment> [<https://perma.cc/R63V-HD3K>].

⁷³ *Kigali Amendment Hits Milestone 100th Ratification, Boosting Climate Action*, UNITED NATIONS ENV’T PROGRAMME (July 14, 2020), <https://www.unep.org/news-and-stories/press-release/kigali-amendment-hits-milestone-100th-ratification-boosting-climate> [<https://perma.cc/JG3P-RPLD>]; Barry G. Rabe, *Ratifying Kigali: Can the U.S. Go the Distance on a Global Climate Treaty?*, BROOKINGS (May 23, 2022), <https://www.brookings.edu/blog/fixgov/2022/05/23/ratifying-kigali-can-the-u-s-go-the-distance-on-a-global-climate-treaty/> [<https://perma.cc/TWM9-5XW4>].

The preceding discussion is not meant to suggest that taxation and regulation have no role in encouraging cooling innovation. But regulation alone seems insufficient for the moment, and the question thus becomes, what other tools are available? Two possibilities include (1) government research grants to innovators, and (2) innovation prizes.

First, when the government grants research funds to innovators in academia and elsewhere, it has the flexibility to, in effect, experiment, without knowing what are the most effective paths to innovation. And government research investments have paid innovation dividends over the years. A substantial percentage of U.S. patents is the product of federal research funding.⁷⁴ The claim that the government invented the internet—via research investments—actually has substantial support.⁷⁵ But it is possible that government grantors will lack the knowledge and imagination to fund some paths to innovation in cooling that actually could be promising. And the reality is that, in the context of cooling infrastructure, there now appears to be limited government research dollars.⁷⁶

Second, governments, philanthropists, or organizations can fund prizes for promising innovations in cooling technology. One advantage of the prize approach is that it does not require the funder(s) to know anything more than what they want to set as the criteria for the winning innovation. Prizes, thus, may tap into the widest possible range of sources of innovation. As Kremer and Williams note, one limitation in prizes to date is that they have rewarded innovators for successful demonstration projects, but such projects are not necessarily scalable for the marketplace.⁷⁷ As they argue, however, there is no reason to exclude possible market viability from the prize criteria, and that has been done in the vaccine development context.⁷⁸

There is, in fact, already a global cooling prize that could serve as a model for other prizes in the arena of cooling infrastructure. This \$3 million global cooling prize involved a “groundbreaking competition . . . designed to incentivize the development of a residential cooling solution that will have

⁷⁴ Lee Fleming et al., *Government-Funded Research Increasingly Fuels Innovation*, 364 SCI. 1139, 1139–41 (2019).

⁷⁵ Michael Moyer, *Yes, Government Researchers Really Did Invent the Internet*, SCI. AM. (July 23, 2012), <https://blogs.scientificamerican.com/observations/yes-government-researchers-really-did-invent-the-internet/> [<https://perma.cc/Q798-9SES>].

⁷⁶ *Department of Energy Announces up to \$47.7 Million for Flexible Building Technologies, Heating, Ventilation, and Air Conditioning (HVAC), and Solid-State Lighting*, OFF. OF ENERGY EFFICIENCY & RENEWABLE ENERGY (Feb. 10, 2020), <https://www.energy.gov/eere/buildings/articles/department-energy-announces-477-million-flexible-building-technologies> [<https://perma.cc/W9ZS-AVL4>].

⁷⁷ Michael Kremer & Heidi Williams, *Incentivizing Innovation: Adding to the Tool Kit*, 10 INNOVATION POL’Y AND ECON. 1, 4–10 (2010).

⁷⁸ *Id.* at 7–10.

at least five times (5X) less climate impact than standard Residential/ Room Air Conditioners (RAC) units in the market today.”⁷⁹ The competition, which was spearheaded by the government of India, focused on the development of a single-room-style, stand-alone air conditioner that could be used broadly to cool portions of homes in India.⁸⁰ The 2021 winners of the prize were described as follows:

Both winning teams, Gree Electric Appliances, Inc. of Zhuhai with partner Tsinghua University, and Daikin with partner Nikken Sekkei Ltd., achieved more than 5X reduction in climate impact against the baseline unit, meeting the primary criteria of the Prize. The Prize administrators also concluded that whilst both teams’ technologies would likely have an initial up-front cost on introduction to the market at two to three times more than the baseline units, lifecycle cost of ownership would be around half that of the baseline unit. This means consumers would experience a simple payback on the higher first cost after just over three years of operation.⁸¹

What may well be needed—or at least helpful—is a range of global cooling prizes designed to foster innovation for the diverse settings where more environmentally friendly and yet affordable cooling technologies are greatly needed.⁸² The India-focused prize concentrated on the kind of cooling technology that would fit in the current Indian culture and homes and might be market competitive there.⁸³ But very different prize criteria would be appropriate for either, say, the urban centers of the United States or rural villages in Sub-Saharan Africa.

Even if widely publicized prizes do not immediately yield marketable innovation, they may attract public attention to the need for innovation in cooling infrastructure. For young scientists and aspiring entrepreneurs and investors, the challenges posed by air conditioning may not seem as exciting—as “cool”—as the challenges opposed by (for example) electric

⁷⁹ *About the Global Cooling Prize*, GLOB. COOLING PRIZE, <https://globalcoolingprize.org/about-the-global-cooling-prize/> [<https://perma.cc/3S8G-R6UL>].

⁸⁰ Underwood, *supra* note 50.

⁸¹ *Breakthrough, Climate-Friendly ACs: Winners of the Global Cooling Prize Announced*, ROCKY MOUNTAIN INST. (Apr. 30, 2021, 11:00 AM), <https://www.prnewswire.com/in/news-releases/break-through-climate-friendly-acs-winners-of-the-global-cooling-prize-announced-857127099.html> [<https://perma.cc/8CX5-BJ5G>].

⁸² There are some other smaller prizes or prize-like grants available; see, for example, *DHS Announces Cooling Solutions Prize Challenge Finalists in Celebration of Earth Day*, DEP’T OF HOMELAND SEC. (Apr. 22, 2022), <https://www.dhs.gov/science-and-technology/news/2022/04/22/dhs-announces-cooling-solutions-prize-challenge-finalists-celebration-earth-day> [<https://perma.cc/B6SQ-WNNG>]; *Nextgen HVAC Innovation Challenges*, EMPOWER INNOVATION, <https://www.empowerinnovation.net/en/custom/funding/view/16650> [<https://perma.cc/X4SP-42P5>].

⁸³ Underwood, *supra* note 50.

cars. As one commentator explained, the actual physical placement of cooling systems may explain this apparent attitude:

But why has the air conditioner changed so little since it was invented back in 1902? According to Ryan Melsert, CEO of finalists M2 Thermal Solutions, it may be due to an “out-of-sight out-of-mind” attitude. “These systems are all around us, in the closets and basements of our homes, in the utility rooms of our businesses, under the hoods of our vehicles,” he said in an email. “But because they are rarely seen, customers are tolerant of this lack of innovation.”⁸⁴

Whatever the reasons, the general acceptance of stasis in cooling technology is no longer tenable. In a warming world, talent has to be attracted to the transformation of cooling technology. It might help a great deal, as absolutely ridiculous as it sounds, if the likes of Jeff Bezos and Elon Musk would stop pondering vacations in space for just a while and talk, even very little, about how to cool a planet in a sustainable way.⁸⁵

III. THE IMMEDIATE CHALLENGE: PREVENT AND RELIEVE SUFFERING FROM EXCESSIVE HEAT

The immediate challenge for cooling in the United States is two-fold. First, people who lack air conditioning or cannot afford to run it when needed must be given access to efficient air conditioning that they actually can operate during very hot weather without sacrificing other life essentials. Second, states and localities must mitigate the effects of increased air conditioning availability and use by upgrading the cooling infrastructure in heat island areas (and, more generally, all areas). In both these contexts, there is an important role to play for not just state and local governments but also the federal government. The question of the appropriate contours of the federal role, in particular, is highlighted by the recent passage of the Inflation Reduction Act, which makes available billions of dollars for heat island mitigation, climate change adaptation generally, and environmental justice.⁸⁶

⁸⁴ *Why It's Time to Redesign the Old Air Conditioner*, AIR CONDITION DEPOT (Oct. 23, 2019), <https://acdepotltd.com/why-its-time-to-redesign-the-old-air-conditioner/> [https://perma.cc/2K6L-7RDG].

⁸⁵ Terry Nguyen, *It's the Dawn of a New Space Age—At Least for Billionaires*, VOX (Feb. 2, 2022, 8:00 AM), <https://www.vox.com/the-goods/22911159/new-space-age-billionaires-culture> [https://perma.cc/QA3D-B5JG].

⁸⁶ For this Article's purposes, the most relevant section of the now-enacted Act is Section 60201, which provides \$3 billion available through September 2026 in grants and technical assistance, with grants benefiting “disadvantaged communities” being available for a number of purposes, including “mitigating climate and health risks from urban heat islands, extreme heat, wood heater emissions, and wildfire events” and “climate resiliency and adaptation.” Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1818 (2022).

A. *Increasing Meaningful In-Home Access To Air Conditioning*

Any expansion of access to air conditioning must first focus on providing efficient, newer air conditioning units to those in need. Efficiency is important for two reasons. First, an overriding goal should be to relieve immediate human suffering while also mitigating environmental harm—and, hence, maximizing efficiency—as much as possible. Second, since tenants often are responsible for air conditioning electricity costs, and those costs are one reason low-income tenants under use or do not use air conditioning,⁸⁷ efficient units will be used more when they are actually needed.

There are three possible approaches to enhancing access: (1) legal mandates on landlords and utilities; (2) subsidies; and (3) targeted, direct provision of air conditioning units. Some of these measures have been adopted in a few jurisdictions in the United States already. In order to meet the full need, all three approaches might be necessary in many jurisdictions. I consider each in turn.

1. *Mandates*

Virtually every large locality has a housing code that mandates that landlords must provide heat during cold weather. For example, the Chicago Housing Code provides that landlords heat apartments to an indoor temperature of “at least 68°F from 8:30 a.m. to 10:30 p.m. and at least 66°F from 10:30 p.m. to 8:30 a.m. for the entire heating season.”⁸⁸ The implied warranty of habitability, which almost all jurisdictions recognize for multifamily rentals,⁸⁹ similarly includes heat as a condition of habitability. In theory, the warranty empowers tenants to withhold rent for lack of heat and/or seek a court order requiring their landlords to provide heat.

Cooling is quite a different story. Only a handful of localities have ordinances requiring landlords to provide any air conditioning.⁹⁰ Air

⁸⁷ Sam Whillans, *Toward a Renter’s Right to Heat-Safe Housing*, NRDC (June 9, 2022), <https://www.nrdc.org/experts/sam-whillans/toward-renters-right-heat-safe-housing> [<https://perma.cc/WWU8-8AZU>] (“Affordability is another major concern. Many lower-income families with access to air conditioning units can’t afford to operate them.”); Will Wade & Mark Chediak, *A ‘Tsunami of Shutoffs’: 20 Million US Homes Are Behind on Energy Bills*, BLOOMBERG (Aug. 23, 2022, 8:05 PM), <https://www.bloomberg.com/news/articles/2022-08-23/can-t-pay-utility-bills-20-million-us-homes-behind-on-payments-facing-shutoffs?smd=premium#xj4y7vzkg> [<https://perma.cc/PH9A-M3SK>].

⁸⁸ *Chicago Heat Ordinance*, CITY OF CHICAGO, https://www.chicago.gov/city/en/depts/bldgs/supp_info/chicago-heat-ordinance.html [<https://perma.cc/YG6C-65W4>] (describing the requirements of CHICAGO, ILL., MUNICIPAL CODE § 802.2.2 (2023)).

⁸⁹ See generally Nicole Summers, *The Limits of Good Law: A Study of Housing Court Outcomes*, 87 U. CHI. L. REV. 145, 147–71 (2020) (reviewing the history of the adoption of the warranty and debates over its effectiveness).

⁹⁰ Whillans, *supra* note 87 (“Nearly everywhere in the United States, landlords have a legal obligation to maintain their rental units in habitable condition. In most places, however, this obligation

conditioning, likewise, has not been held to be part and parcel of the implied warranty of habitability.⁹¹ Thus, unless the landlord has expressly or impliedly promised to provide air conditioning as part of the lease contract, the tenant has no right to it.

Disabled tenants are particularly vulnerable to heat, but the relevant statutes regarding disability also do not mandate air conditioning in any meaningful way. For example, the Fair Housing Act (FHA) does require landlords to make reasonable accommodations for the disabilities of tenants, but landlords are not required to make an accommodation if it would impose an undue financial burden.⁹² The test for what is an undue financial burden is highly fact specific: “The determination of undue financial and administrative burden must be made on a case-by-case basis involving various factors, such as the cost of the requested accommodation, the financial resources of the provider, the benefits that the accommodation would provide to the requester, and the availability of alternative accommodations that would effectively meet the requester’s disability-related needs.”⁹³ In other words, being disabled in a way that makes lacking air conditioning dangerous does not straightforwardly give a tenant any *per se* right to air conditioning. Even when the tenant clearly could show her need and that there was no undue burden, there is no simple, fast, and unproblematic legal process that would necessarily compel compliance on the part of the landlord. For this reason, commentators have urged the adoption of housing code amendments requiring air conditioning and incorporating adequate cooling into every jurisdiction’s implied warranty of habitability.⁹⁴

does *not* extend to providing an air conditioner or other indoor cooling device. Air conditioners also are not required in federal public housing.”); Suzy Khimm & Joshua Eaton, *As Deadly Heat Waves Spread, Access to Air Conditioning Becomes a Lifesaving Question*, NBC NEWS (Aug. 20, 2021, 10:10 AM), <https://www.nbcnews.com/news/us-news/deadly-heat-waves-spread-access-air-conditioning-becomes-lifesaving-question-n1277213> [<https://perma.cc/DWB4-DZB9>] (“requirements for landlords to provide air conditioning or for new buildings to have cooling devices remain rare . . . in most other states, there are no statewide or broad local mandates for cooling devices in housing, and the federal government similarly has no cooling requirements for publicly subsidized properties.”).

⁹¹ Gerrard, *supra* note 2, at 538; Allison Rebecca Penn, *Landlords, Are You Responsible for Air Conditioning?*, ALL PROP. MGMT. (June 17, 2019), <https://www.allpropertymanagement.com/blog/post/landlord-responsibilities-for-air-conditioning/> [<https://perma.cc/KZ5N-GTZH>] (discussing the elements of the implied warranty).

⁹² *Reasonable Accommodations Under the Fair Housing Act*, OFF. OF FAIR HOUS. AND EQUAL OPPORTUNITY (May 14, 2004), <https://www.justice.gov/crt/us-department-housing-and-urban-development> [<https://perma.cc/TP9E-7Y7S>].

⁹³ *Id.*

⁹⁴ *See, e.g.*, Gerrard, *supra* note 2, at 543 (“State legislatures should expand the warranty of habitability to require landlords to provide tenants with protection against heat as well as cold.”).

Mandates certainly are called for, but legal mandates alone are not enough. For one thing, housing codes are wildly underenforced.⁹⁵ The available evidence suggests that few tenants who invoke the implied warranty of habitability are successful in improving conditions in their housing.⁹⁶ Given the shortage in affordable housing and the vulnerability of the poorest tenants to eviction for being in arrears on their rent, many poor tenants who lack air conditioning might not even think about trying to take advantage of even a strongly-worded legal entitlement to cooling.⁹⁷ And, it is possible that if mandates did result in new or better air conditioning, landlords would try to pass the cost on to low-income tenants who cannot really even afford their current rent.

Yet another limitation of mandates is that they may not promote the use of the most efficient air conditioning units or systems available. Those landlords who do comply with mandates might well opt for cheap new, or even cheaper used units, which are both inefficient because their tenants may bear the electricity costs, and even if they do not, the landlords may take a short-term, cash flow-maximizing, and investment-minimizing approach to the low-income housing they own. If that is the case, even if mandates were to result in more air conditioning, the new air conditioning may unnecessarily add to greenhouse gas emissions and/or be too expensive for tenants who cannot afford to run as much as needed.

Another relevant legal mandate, which applies to both low-income owners and tenants, is the mandate that utility companies refrain from shutting off utilities during extreme weather and/or offer flexible payment plans so customers can pay off extreme weather charges over an extended time like 10 months.⁹⁸ Many states have a mandate of this sort that applies during the winter months.⁹⁹ Some such as Georgia extend protections to periods of extreme heat.¹⁰⁰ But some states that now experience very hot weather—such as Kentucky—only have protections for cold weather

⁹⁵ Sabbeth, *supra* note 16, at 129–31 (2019) (discussing the under-enforcement of tenant rights by underfunded public authorities).

⁹⁶ See Summers, *supra* note 89, at 198–99.

⁹⁷ David A. Super, *The Rise and Fall of the Implied Warranty of Habitability*, 99 CALIF. L. REV. 389, 423–34 (2011) (discussing reasons low-income tenants choose not to try to enforce the implied warranty); David A. Dana, *An Invisible Crisis in Plain Sight: The Emergence of the “Eviction Economy,” Its Causes, and the Possibilities for Reform in Legal Regulation and Education*, 115 MICH. L. REV. 935, 941–45 (2017) (discussing why the “Eviction Economy” has arisen in the United States).

⁹⁸ Jon McNamara, *Consumer Protection Laws and Regulations on Heating and Utility Disconnections*, NEED HELP PAYING BILLS, https://www.needhelp-payingbills.com/html/utility_and_heating_disconnect.html [https://perma.cc/X63S-KTU9].

⁹⁹ *Id.*

¹⁰⁰ *Id.*

months.¹⁰¹ And Florida, where the issue, of course, is almost always extreme heat, has no protections at all.¹⁰²

All states should extend protections for periods of extreme heat. And if they do not do so, Congress should encourage them to do so. Although retail power issues traditionally are a domain of state and not federal jurisdiction, Congress could incentivize states to extend protections by tying energy-related or other funding to the extension of protections to low-income utility customers.¹⁰³ Of course, these sorts of no-shutoff mandates do not solve the basic issue of affordable access to cooling, but they may help vulnerable people from succumbing to extreme heat until other legal and policy interventions can expand affordable access.

2. *Subsidies*

An alternative approach to mandates is subsidies. The federal government provides substantial funding through two closely related programs that are, or could be, relevant to meeting the need for air conditioning for low-income people: the Low Income Home Energy Assistance Program (LIHEAP) and the Weatherization Assistance Program (WAP).¹⁰⁴ LIHEAP “assists eligible low-income households with their heating and cooling energy costs, bill payment assistance, energy crisis assistance, weatherization and energy-related home repairs.”¹⁰⁵ On the other hand, WAP assists “income-eligible families and individuals reduce heating/cooling costs and improve the health and safety of residences through the installation of energy efficiency measures.”¹⁰⁶

There are several problems with these programs as a means to meet the immediate challenge of protecting vulnerable people from the heat. First, the federal government allows states broad leeway as to how to spend any

¹⁰¹ *Id.*

¹⁰² *Id.*

¹⁰³ Congress cannot simply mandate that states enact anti-shutoff laws because, under the Tenth Amendment as interpreted by the Supreme Court, Congress may not commandeer state or local lawmakers. Matthew D. Adler, *State Sovereignty and the Anti-Commandeering Cases*, 574 ANNALS AM. ACAD. POL. & SOC. SCI. 158, 163–165 (2001) (discussing the rationale and history of the anti-commandeering doctrine).

¹⁰⁴ For the somewhat complicated statutory basis for LIHEAP and WAP, see *LIHEAP Statute and Regulations*, U.S. DEP’T OF HEALTH & HUM. SERVS. (Aug. 21, 2020), <https://www.acf.hhs.gov/ocs/law-regulation/liheap-statute-and-regulations> [<https://perma.cc/ZQM9-RREH>] and *Federal WAP Regulations & Statutes*, NAT’L ASSOC. FOR STATE CMTY. SERVS. PROGRAMS, <https://nascsp.org/wap/waptac/regulations/> [<https://perma.cc/4FE8-HTUL>].

¹⁰⁵ *Low Income Home Energy Assistance Program (LIHEAP)*, BENEFITS.GOV, <https://www.benefits.gov/benefit/623> [<https://perma.cc/W5DE-MXBY>].

¹⁰⁶ U.S. DEP’T OF HOUS. AND URB. DEV., MULTIFAMILY WEATHERIZATION INITIATIVE: FACT SHEET 1 (2010), https://www.hud.gov/sites/documents/fsweather_proc_mf_building.pdf [<https://perma.cc/HY8T-ANJ6>].

allocated funds, which means states need not use (or prioritize the use of) the funds to meet cooling needs. LIHEAP currently allows each state “to decide how much to spend on heating assistance and how much—if anything—it’s going to spend on cooling assistance.”¹⁰⁷ States have tended to prioritize heating over cooling needs.¹⁰⁸ A few have reacted to recent heat waves by directing substantial LIHEAP funds to cooling assistance. For example, last summer, after a heat dome brought record-breaking temperatures to the Pacific Northwest, Washington directed LIHEAP’s funds to help low-income families buy air conditioners and help them pay the bills.¹⁰⁹ However, even in states such as Illinois that, in theory, extend LIHEAP to cooling needs, there is, in practice, little or no money left by the summer,¹¹⁰ notwithstanding recent boosts to LIHEAP funding.¹¹¹

To meet this need, the federal government should require states to meaningfully fund cooling needs. Cash-strapped states that face both cold and heat challenges (such as Illinois) might object that more funds are needed to meet heating and cooling needs. The ideal solution, therefore, might be to tie enhancements in LIHEAP funding to the establishment of a cooling mandate.

¹⁰⁷ Samantha Fields, *A Program Designed to Help Low-Income People Pay for Heating Faces the Need to Pay for AC*, MARKETPLACE (May 17, 2022), <https://www.marketplace.org/2022/05/17/a-program-designed-to-help-low-income-people-pay-for-heating-faces-the-need-to-pay-for-ac/> [https://perma.cc/5W4A-NNVP].

¹⁰⁸ Rebecca Leber, *The US Could Stop One Cause of Heat Wave Deaths Tomorrow*, VOX (Aug. 3, 2022, 7:00 AM), <https://www.vox.com/science-and-health/23274788/heat-wave-ac-energy-bill-utilities> [https://perma.cc/JN9H-JDWU] (“Cooling tends to be overlooked at every level of government. The designated federal program to help low-income consumers, the Low Income Home Energy Assistance Program (LIHEAP), spends 85 percent of its funds on heating in winter, rather than cooling in summers . . .”).

¹⁰⁹ Fields, *supra* note 107.

¹¹⁰ Sarah Macaraeg, *Climate Change Is Turning Air Conditioning into a Matter of Life and Death. But Government Help Is Lacking*, CHI. TRIB. (Aug. 7, 2022, 5:00 AM) <https://www.chicagotribune.com/investigations/ct-air-conditioning-help-chicago-climate-change-20220807-o5spgwoqndotnwetgv7s6puui-htmlstory.html> [https://perma.cc/E4PC-ZJEW] (explaining that LIHEAP “applications aren’t taken from June through August, when heat waves and heat deaths tend to occur.”); Alyssa Patrick, *Limited Energy Assistance Programs Available During Heat Wave*, WAND (June 15, 2022), https://www.wandtv.com/news/limited-energy-assistance-programs-available-during-heat-wave/article_5deb3756-ed16-11ec-a930-6b55409fb13f.html [https://perma.cc/HSK3-VSL2] (“For families struggling to pay their power bill, there are not as many options available this time of year. Illinois’ Low Income Energy Assistance Program (LIHEAP) is already closed for the year.”).

¹¹¹ *The White House Announces Additional \$385 Million to Lower Home Energy Bills for American Families*, THE WHITE HOUSE (Apr. 21, 2022), <https://www.whitehouse.gov/briefing-room/statements-releases/2022/04/21/fact-sheet-white-house-announces-additional-385-million-to-lower-home-energy-bills-for-american-families/> [https://perma.cc/XC8G-M3A9].

Second, while the WAP program places energy efficiency at its core, LIHEAP does not have efficiency as a goal or clear criteria.¹¹² Thus, to the extent that LIHEAP programs in the states address cooling needs, they may do so in ways that do not encourage or require efficient cooling. LIHEAP by itself also does not necessarily promote the purchase and use of the most efficient (and generally more expensive) air conditioning units and systems, but (as noted above) that is important both for climate change mitigation reasons and so that utility costs are sustainable for consumers. To the extent LIHEAP is used for the purchase of cooling systems by low-income owners and tenants, it should provide sufficient funding for the purchase of efficient ones.

For its part, WAP does focus on efficiency and specifically can be used to fund an upgrade from inefficient air-cooling systems to more efficient ones. WAP also encompasses not just low-income owners and tenants, but also owners of low-income housing as part of its multifamily weatherization program.¹¹³ However, at least on its face, WAP has a gap as far as helping to subsidize the installation of efficient air conditioners in housing that currently lacks any or has incomplete air conditioning.¹¹⁴ Thus, adding air conditioning where there was none does not easily fit in the realm of enhancing efficiency and reducing energy consumption and, thus, would seem to fall outside the scope of WAP.¹¹⁵

If the federal government clarified (and urged) that WAP funds can and should be used to add air conditioning to housing—in particular multifamily housing—that would help speed up the addition of air conditioning to the low-income housing that currently lacks it. Much of that housing is low-income, multifamily housing. Indeed, WAP plus a mandate may be the best approach: if there were a mandate for landlords to provide air conditioning, plus an available subsidy to help them do so and do so in an energy-efficient way, then perhaps local housing officials and courts would be more willing to really enforce the mandate. Moreover, under WAP, states can (and should)

¹¹² See Sophia Mariam, *LIHEAP and WAP: A Dynamic Duo for Reducing the Low-Income Energy Burden*, NASCSP, <https://nascsp.org/liheap-and-wap-a-dynamic-duo-for-reducing-the-low-income-energy-burden/> [<https://perma.cc/697Y-8XWA>] (explaining that LIHEAP addresses households' needs to pay energy bills, while WAP addressed energy efficiency, and also noting that some portion of LIHEAP funding sometimes can be allocated to WAP by a state).

¹¹³ *Illinois Home Weatherization Assistance Program (IHWAP)*, CITIZENS UTIL. BD., <https://www.citizensutilityboard.org/illinois-home-weatherization-assistance-program-ihwap/> [<https://perma.cc/2DYD-UHMT>].

¹¹⁴ See U.S. DEP'T OF ENERGY, WEATHERIZATION ASSISTANCE PROGRAM 2 (2021), https://www.energy.gov/sites/default/files/2021/01/f82/WAP-fact-sheet_2021_0.pdf [<https://perma.cc/G6PM-YD54>] (listing services covered by WAP but omitting installation of cooling systems where the structure lacked any).

¹¹⁵ See *id.*

condition funds to landlords on limited guarantees against rent increases, so the added value of having air conditioning does not immediately translate into a rent increase.¹¹⁶

Of course, subsidy programs, even with the improvements suggested, have their limitations. Low-income households have to know about the programs and be able to apply (including having the ability to fill out forms and gather documentation), and that may leave out some of the households most in need. Both LIHEAP and WAP, moreover, seem to exclude undocumented persons and persons on temporary visas. And subsidy programs can be a slow way to receive help, and in the face of heat waves, slow is not satisfactory with respect to those who are most vulnerable.

3. *Direct Provision of Air Conditioning*

A third alternative for governments, distinct from mandates or subsidies, is for local governments to reach out to households most in need of air conditioning and directly purchase and install efficient air conditioning where there was none or where there was only inefficient air conditioning in place. This can be an especially apt option for addressing the needs of disabled, low-income households who face the greatest risks from heat but who might not be able to take advantage of application-based subsidy programs. Direct provision can be a faster solution than the traditional subsidy approach, although in some places (such as Dallas County) it draws its funding from the subsidy programs.¹¹⁷ In Multnomah County, Oregon, near Portland, the County employs social workers to identify families most in need and installs new air conditioning:

Cox, an East County resident, didn't have air conditioning at home. As the caretaker for her grandson who has special needs, she saw firsthand how the heat was affecting him Everything changed when an outreach worker from Multnomah County Disability Services offered to connect Cox with an air conditioning unit. Within days, crews were out installing a unit in her grandson's bedroom.¹¹⁸

Direct provision as in Dallas and Multnomah County may seem too expensive to many localities. It entails outreach costs that the traditional

¹¹⁶ *Multifamily Weatherization Initiative: Fact Sheet*, *supra* note 106, at 3 (“Building owners may need to provide documentation and verification that tenants are protected against rent increases that are directly related to the weatherization work.”).

¹¹⁷ Demond Fernandez, *Some Dallas County Residents Are Receiving Free A/C Units amid Heatwave*, WFAA (June 10, 2022, 6:21 PM), <https://www.wfaa.com/article/news/local/dallas-county-residents-receiving-free-ac-units-heatwave/287-3eecd4be-816c-40ec-83d7-a831161a8729> [<https://perma.cc/BC7N-AHPH>].

¹¹⁸ *County Installs Air Conditioners for Vulnerable Households Ahead of Heat Wave*, MULTNOMAH CNTY. (July 28, 2022), <https://www.multco.us/sustainability/news/county-installs-air-conditioners-vulnerable-households-ahead-heat-wave> [<https://perma.cc/97GA-UTHY>].

subsidy approach does not. A full cost–benefit analysis, however, might support the view that direct provision is an efficient way to meet the cooling needs of those most vulnerable to extreme heat.

B. The Provision Of Cooling Infrastructure By States and Localities

Cooling infrastructure, writ large, includes all the features of buildings and surrounding areas that create or mitigate heat island effects. It also plausibly includes infrastructure such as cooling centers and other cool public spaces and emergency services for people in need during heat waves.¹¹⁹ As localities across the United States have begun to recognize, addressing global heating requires not only greater availability of air conditioning but also better cooling infrastructure to lower heat island effects and mitigate any additional heat from the increased use of air conditioning.¹²⁰ One question is: Who will provide that better infrastructure?

In the United States, cooling infrastructure directly implicates local governments, as they own and control much of the relevant areas (streets, sidewalks, even trees), they establish codes for buildings, and via the zoning power and other local powers, they exert substantial control over the mix and density of uses in an area and transportation patterns. In our political and legal traditions, the task of enhancing cooling infrastructure will, thus, invariably fall to local governments.

Moreover, local control of cooling infrastructure makes sense for several reasons beyond legal and political traditions. For one thing, local circumstances vary: trees planted in one city may not thrive in another;¹²¹ pavement surfaces in one area may be highly reflective but unsuitable for the setting but work well elsewhere.¹²² A certain kind of cooling center in one community might attract people in need but go unused in another. A program

¹¹⁹ Chicago, in fact, has made cooling centers the keystone of its recent ordinance addressing heat wave risks. *2022 Cooling Ordinance*, CITY OF CHI., https://www.chicago.gov/city/en/depts/bldgs/supp_info/cooling-requirements.html [https://perma.cc/S3CH-67MM].

¹²⁰ See Gerrard, *supra* note 2, at 530–34; Katie Pyzyk, *As Heat Island Effects Worsen Due to Climate Change, Cities Try to Adapt*, SMARTCITIESDIVE (Aug. 17, 2021), <https://www.smartcitiesdive.com/news/as-heat-island-effects-worsen-due-to-climate-change-cities-try-to-adapt/604915/> [https://perma.cc/W4KU-TSFE].

¹²¹ Choosing the correct trees for an urban environment requires a careful assessment of current and future climate conditions in that specific location, among other things. See, e.g., Leslie A. Brandt et al., *Vulnerability of Street Trees in Upper Midwest Cities to Climate Change*, 9 FRONTIERS IN ECOLOGY & EVOLUTION 1, 1 (2021) (finding that differences in projected summer high temperatures had a primary effect on the number of vulnerable trees in different locations).

¹²² Hessam AzariJafari & Randolph E. Kirchain, *Lighter Pavement Really Does Cool Cities When It's Done Right*, THE CONVERSATION (June 18, 2021, 8:29 AM), <https://theconversation.com/lighter-pavement-really-does-cool-cities-when-its-done-right-162918> [https://perma.cc/XQ3C-837Q] (explaining why location matters in selecting the best pavement for heat mitigation).

to require (with funding) the retrofit of building roofs into white, reflective, cool roofs might be architecturally feasible and politically palatable in some communities but not others.

Moreover, every cooling infrastructure decision could have impacts beyond cooling. For example, tree planting may take up sidewalk space businesses or community groups otherwise want/need to use, increase property values and raise gentrification concerns, and decrease crime risks by making people more comfortable being outdoors. Or, conceivably, tree planting could increase crime by decreasing visibility. Local officials, presumably, are best positioned to understand the various trade-offs and make the best decisions on balance.

At the same time, there clearly is a role for the federal government. Indeed, cooling infrastructure is exactly the kind of issue or problem for which Dorf's and Sabel's model of federalism as "democratic experimentalism"¹²³ seems apt; that is, it is a complicated, site-specific problem, but also one in which the federal government can play an important coordinating role while safeguarding certain national values. Legally and politically, the federal government has broad opportunities to do so, because it will be a major funder for local cooling infrastructure projects.

After years in which legislation providing federal funding for cooling infrastructure was proposed but not passed,¹²⁴ the Inflation Reduction Act allocated billions of dollars to address (among other things) heat islands, climate change adaptation, and environmental justice.¹²⁵ The Act is silent as to what the larger federal role should be in shaping how community groups, localities, states, and tribes improve cooling infrastructure in and around heat islands, as well as elsewhere.¹²⁶ The Act's language references "grants" by

¹²³ Michael C. Dorf & Charles F. Sabel, *A Constitution of Democratic Experimentalism*, 98 COLUM. L. REV. 267, 314–23 (1998).

¹²⁴ Senator Markey has long trumpeted this cause. *See, e.g.*, Press Release, Edward J. Markey, Following North America's Hottest June on Record, Senators Markey and Padilla Introduce Legislation to Combat Health Risks of Extreme Heat, Provide \$100 Million in Heat-Fighting Financial Assistance (July 28, 2021), <https://www.markey.senate.gov/news/press-releases/following-north-americas-hottest-june-on-record-senators-markey-and-padilla-introduce-legislation-to-combat-health-risks-of-extreme-heat-provide-100-million-in-heat-fighting-financial-assistance> [<https://perma.cc/B2X7-MA47>] (discussing Senator Markey's reintroduction of legislation that seeks to address illnesses and deaths resulting from extreme heat waves).

¹²⁵ THE WHITE HOUSE, BUILDING A CLEAN ENERGY ECONOMY: A GUIDEBOOK TO THE INFLATION REDUCTION ACT'S INVESTMENTS IN CLEAN ENERGY AND CLIMATE ACTION 86 (2023), <https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf> [<https://perma.cc/K9AA-8YK7>].

¹²⁶ *See* Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1818 (2022).

the federal government but says nothing about the criteria for the grants or the broader structure of grant programs.¹²⁷

At least three values should govern the federal government's role with respect to funding local cooling infrastructure: (1) promoting innovation, (2) disseminating knowledge, and (3) addressing continuing inequalities in treatment among communities in states and localities. As to innovation, a good deal remains to be learned about what are the best, most efficient ways to mitigate heat island effects and reduce risk in the many places where that will be needed. The federal government could reserve a portion of funding for innovative projects—for example, projects using different surface paving than has previously been employed. Even if the federal government does not prioritize innovation in that way, it could assist innovation by assessing and publishing the costs and, to the extent they can be measured, benefits of various local projects.

Relatedly, the federal government can more broadly disseminate knowledge about how localities should engage in heat mitigation efforts. Private consultants are available, but the federal government can provide unbiased and perhaps more cost-effective assistance, especially as it accumulates experience with funding and reviewing efforts across the country.

Finally, the federal government can and should use its, now very substantial, funding power to help ensure that the mitigation of heat island effects through local public investments, zoning, and other regulation takes into account the needs of all communities and does not ignore or underinvest in some communities that are particularly lacking in political power. As noted, a disproportionate number of extreme heat island areas are located in very low-income, often predominately Black, Latino, Native American, or Indigenous neighborhoods or areas.¹²⁸ The same political and cultural dynamics that lead to these communities having the characteristics of heat islands could, at least sometimes in some states, lead them not to seek funding on their own (where that is possible) or not to be included (or not included appropriately) in larger localities or states' funding requests and budgets.¹²⁹ The federal government could require that each state receiving (or that has localities receiving) heat mitigation funding take measures to address the needs of the communities most in need; since the federal

¹²⁷ *Id.*

¹²⁸ See Sullivan, *supra* note 38.

¹²⁹ *Heat Islands and Equity*, EPA (Dec. 12, 2022), <https://www.epa.gov/heatislands/heat-islands-and-equity> [<https://perma.cc/YY6Z-G2ZT>] (noting that heat islands themselves may reflect the inequitable history of how communities are planned, developed, and maintained).

government is leading efforts to map heat islands,¹³⁰ it could use its mapping expertise to assess whether the requested state and local funding corresponds to the areas of greatest need as per current mapping and engage in a dialogue with states as to how they could do more to achieve equity and meet the greatest needs.

This equality-as-a-condition approach could be subject to legal challenge, depending on how courts read the scope of rulemaking authority under the language of the statute.¹³¹ Pragmatic concerns also will play a role: the more procedural and substantive requirements there are for states to ensure equity among communities in need, the longer it may take for funding decisions to be made and heat mitigation to be put in place. But the federal government is singularly positioned to assure that states and localities counter, and certainly do not replicate patterns of environmental injustice, as they enhance cooling infrastructure in and around our Built Environment.

IV. COOLING SECURITY AND U.S. NATIONAL SECURITY

There are three major linkages between the challenges described above and U.S. national security. Taken together, these linkages argue for including what I am terming “cooling security” in the discourse about national security and climate change.

First, if the long-term challenge of developing new cooling technologies that are affordable is not met, the lack of access to such cooling may directly foment political instability in already volatile parts of the world. All, or almost all, the nations that have been identified as at high risk of political instability are ones that now face extreme heat.¹³² When people

¹³⁰ *NOAA Summer Urban Heat Mapping*, NAT’L OCEANIC & ATMOSPHERIC ADMIN. (May 27, 2022), <https://www.noaa.gov/media-advisory/noaa-summer-urban-heat-mapping> [https://perma.cc/63XD-LZ8Z]; *NOAA and Communities to Map Heat Inequities in 14 U.S. Cities and Counties*, NAT’L OCEANIC & ATMOSPHERIC ADMIN. (Aug. 10, 2022), <https://www.noaa.gov/news-release/noaa-and-communities-to-map-heat-inequities-in-14-us-cities-and-counties> [https://perma.cc/G34K-SUMP].

¹³¹ One question is whether the spare language of the Inflation Reduction Act is read to give regulators broad deference to require that states demonstrate an equitable distribution of funds and equitable reductions in heating as a condition of receiving grants. Under typical principles of Chevron deference, federal regulations with such requirements would be deemed reasonable and hence lawful interpretations of the statute. On the other hand, the statute does not have any text that suggests states are responsible for equitable distribution of fund and reductions in heating as a condition for the states or localities in it receiving funds, and the status of Chevron deference is now an open question. On Chevron’s current status, see Cass R. Sunstein, *On Overruling Chevron* (Nov. 1, 2020), <https://papers.ssrn.com/a=3723681> [https://perma.cc/2EP7-VACA].

¹³² See *10 Conflicts to Worry About in 2022*, ACLED (Feb. 2022), <https://acleddata.com/10-conflicts-to-worry-about-in-2022/> [https://perma.cc/BFV8-LSB9] (listing Yemen, Nigeria, Myanmar and a number of other Southern Hemisphere nations as poised for political instability and armed conflict). For example, Yemen is already suffering from climate-related effects, including heat. Helen Lackner & Abulrahman Al-Eryani, *Yemen’s Environmental Crisis Is the Biggest Risk for Its Future*, THE CENTURY

cannot afford and access the power for air conditioning, we have already seen that violence can ensue: in 2011 and 2012, for example, power outages in Pakistan during “a sweltering summer” led to “mass-scale protests” throughout that nation.¹³³ While “[t]he connection between climate change and the revolutions and wars of the Arab Spring is hotly debated,” experts believe that “there are clear and unarguable linkages between poor governance, environmental mismanagement, urbanization, and urban unrest in communities poorly served with water, air conditioning, and other amenities.”¹³⁴ Absent reliable cooling that is affordable, the continuing warming of the planet will add more and more to threats of political instability around the world and hence to threats to U.S. national security.

Second, even if air conditioning were to become widely available worldwide but only in its current forms that contribute to climate change, national security will be threatened by the added warming of the planet attributable to such environmentally unsustainable cooling. That added warming will translate into added extreme weather events, added droughts, added famines, added sea level rise, and added climate-related migration of refugees—all of which will pose problems for U.S. national security.¹³⁵ In other words, if tackling climate change writ large is a national security imperative, finding ways to make cooling environmentally sustainable also must be a national security imperative.

Finally, it is important for U.S. standing in the world, and hence national security, that the United States be perceived as a nation that can humanely meet the needs of its population, including people of all incomes and backgrounds. And cooling is surely one of those needs, now more than ever. A country that cannot meet its own population’s needs is simply not well poised to urge leaders in *other* countries to prevent or limit discord by meeting the needs of their populations. As Scott Kennedy observes, “[b]etter American performance on metrics concerning governance, health, tolerance, and the environment will raise its soft power, and in turn, provide a

FOUND. (Dec. 14, 2020), <https://tcf.org/content/report/yemens-environmental-crisis-biggest-risk-future/> [<https://perma.cc/LJ3B-5U9Y>]; Foad A. Harazi, *Future Impact of Climate Change Visible Now in Yemen*, THE WORLD BANK (Nov. 24, 2014), <https://www.worldbank.org/en/news/feature/2014/11/24/future-impact-of-climate-change-visible-now-in-yemen> [<https://perma.cc/KT9M-EVE9>].

¹³³ See NAT’L RSCH COUNCIL, CLIMATE AND SOCIAL STRESS: IMPLICATIONS FOR SECURITY ANALYSIS 123 (John D. Steinbruner et al. eds., 2013).

¹³⁴ See Anchal Vohra, *The Middle East Is Becoming Literally Uninhabitable*, FOREIGN POL’Y (Aug. 24, 2021, 8:48 AM), <https://foreignpolicy.com/2021/08/24/the-middle-east-is-becoming-literally-uninhabitable/> [<https://perma.cc/T85C-NMKX>].

¹³⁵ For example, on the connections between climate-related sea level rise and national security, see RONALD KEYS ET AL., CTR. FOR CLIMATE & SEC., MILITARY EXPERT PANEL REPORT: SEA LEVEL RISE AND THE U.S. MILITARY’S MISSION (Shiloh Fetzek et al. eds., 2016), <https://climateandsecurity.org/militaryexpertpanel/> [<https://perma.cc/D7AP-FVL5>].

foundation for strengthening its hard power.”¹³⁶ One of those metrics is the extent to which all Americans are protected from suffering and even death from extreme heat.¹³⁷

CONCLUSION

The world needs better cooling infrastructure. One challenge is to promote genuine innovation in cooling technology, which will require more than the slow regulatory push toward greater energy efficiency and safer refrigerants we have seen so far. In the immediate term, legal mandates along with subsidies and direct provisions are needed to provide air conditioning to those most in need in the United States. State and local governments need to invest in cooling infrastructure outside homes and other buildings, and the federal government needs, among other things, to ensure equity in those investments. Taking on these challenges will be good not only for the fight against climate change as a whole and for the most vulnerable populations in the United States but also for U.S. national security.

¹³⁶ See Scott Kennedy, *The U.S. and China: Not Number One*, CTR. FOR STRATEGIC & INT’L STUD. (Dec. 21, 2020), <https://www.csis.org/blogs/trustee-china-hand/us-and-china-not-number-one> [<https://perma.cc/GT8K-P4G5>].

¹³⁷ For a recent attempt to compare and implicitly rank countries on the availability of air conditioning and the associated prevention of heat-related deaths, see Francesco Sera et al., *Air Conditioning and Heat-Related Mortality: A Multi-country Longitudinal Study*, EPIDEMIOLOGY (Nov. 2020), <https://pubmed.ncbi.nlm.nih.gov/33003149/> [<https://perma.cc/F8DA-7NKZ>].