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A GREEN NEW DEAL FOR AMERICAN PUBLIC HOUSING COMMUNITIES

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The Green New Deal for Public Housing Act, proposed by Rep. Alexandria Ocasio-Cortez and Sen. Bernie Sanders in November 2019, would undertake a decade of decarbonization and capital repairs to the country's public building stock (that is, homes managed by Public Housing Agencies (PHAs) as well as some tribal housing), tackling climate change and inequality at the same time.

As articulated in House Resolution 109, introduced by Rep. Alexandria Ocasio-Cortez and sponsored in the Senate by Sen. Ed Markey, the Green New Deal's core priorities include aggressive cuts to greenhouse gas emissions, widespread green job creation, and addressing inequalities of race and class. The resolution explicitly calls for direct green investment in frontline communities as a way to achieve these goals in the short term.

This targeted investment is often critiqued as an expensive and distracting add-on to decarbonization. But in fact, green social policy is a strategic lever to slash emissions directly by eliminating fossil fuel use and indirectly by growing the coalition for decarbonization.

The Green New Deal for Public Housing Act is a wise use of resources: the public sector already owns the buildings; they are in desperate need of maintenance already; green retrofits that slash carbon emissions, improve health and comfort, build community resiliency centers, and create jobs in neighborhoods with high unemployment, will together make huge improvements to people's everyday lives while building political support for more climate action. Indeed, we hope to soon develop legislation that extends these principles to other pieces of the low-income and affordable housing system.

Following the broad contours of the Green New Deal for Public Housing Act, this report estimates that with $119 to $172 billion of federal investment over ten years it would be possible to decarbonize more than one million units of the country's public housing stock—the equivalent of taking 1.2 million cars off the road every year. These same retrofits would eliminate lead, mold, and other health hazards that plague the nearly 2 million people who live in America's public housing and backfill the massive existing and accrual needs that have plagued existing public housing for decades. All this would create over 240,000 jobs per year, including tens of thousands of high-paying construction and maintenance jobs for public housing residents and nearby low-income workers.

This investment would cover both all necessary short-term and capital repairs *and* holistic building retrofits. Pairing green retrofits with immediate and deep capital repairs is the most efficient and cost-effective way to reach the twin goals of making public housing healthy, safe, and desirable for all residents and upgrading building systems to the highest 21st century green standards. Indeed, this investment will do even more—it will develop new labor skills and building upgrade techniques that will facilitate no-carbon green retrofits of other residences and commercial buildings across the country.

Summary of Benefits

▶ **Invest $119 to $172 billion in green retrofits that include all needed capital repairs, vastly improved health, safety and comfort, and eliminate carbon emissions.** This would hugely improve the living conditions of nearly two million people, living in roughly one million units.

▶ **Create up to 240,723 jobs per year nationally across multiple sectors**, thanks to the injection of billions of dollars into the 21st century green retrofit economy. (For all jobs and economic projections, see Appendix forthcoming in full report.)

▶ **Directly create from 22,297 to 35,755 career-track, high-paying jobs per year in skilled maintenance and construction for public housing residents**, with average wages depending on state. As examples, average wages in construction are $69,992 in California, $61,828 in Colorado, and $61,620 in Georgia. These are comparable to early-career union rates.

▶ **Create jobs throughout the national economy, with construction jobs concentrated in areas with a significant number of public housing units.** Based on our estimates, this program will bring up to 222 on-site construction jobs per year to IL-07 (Chicago), 256 to MA-07 (Boston), 123 to MI-13 (Detroit), 179 to MN-05 (Minneapolis), and due to its large concentration of public housing, 4,406 on-site maintenance and construction jobs per year to Puerto Rico.

▶ **Create constructions jobs that cross partisan divides.** Because public housing is widespread across the country's political divides, these investments would create more skilled construction and maintenance jobs per year for public housing residents in red states (up to 17,489) than blue states (up to 9,428), with party affiliation based on which party won the most votes in the 2016 presidential election. At the congressional district level, however, there would be more jobs for public housing residents in blue districts (up to 14,224) than red (up to 12,168), with party affiliation based on the 2018 midterm congressional election.

▶ **Reduce annual carbon emissions by roughly 5.6 million metric tons annually compared to recent years, the equivalent of taking over 1.2 million cars off the road.** We achieve this through electrification, increased energy efficiency, renewable energy purchase and solar panel installation, and the removal of fossil fuels from building systems.

▶ **Reduce public housing water bills by up to 30% per year, or $97 million.**

▶ **Reduce public housing energy bills by up to 70% per year, or $613 million dollars.**

Why America's Public Housing Needs a Green New Deal

Public housing is found all over the country and is managd by local authorities. As there is a lack of comprehensive, national level data on public housing conditions countrywide, this report is largely concerned with outlining likely costs, likely economic and environmental benefits, mapping where the work would be done, and explaining some of the core tasks of green retrofits in different contexts. A more detailed analysis of a Green New Deal for NYCHA—New York's public housing authority, by far the largest in the country—can be found in our companion report, "A Green New Deal for NYCHA Communities."

The current situation of national public housing is desperate. A Department of Housing and Urban Development (HUD) 2010 study estimated the capital needs deficit of the country's roughly 1.1 million public housing units. It estimated that at that time, the nation's public housing stock required $25.6 billion in capital repairs to address endemic conditions of ill repair, from peeling lead paint, to molding or rotting subflooring, to failing HVAC systems. **HUD estimated that there would be a total need for $89 billion worth of repairs and ongoing accrual costs in public housing over the 20 year timeframe to 2030**—assuming that the original repair needs were filled in an orderly fashion starting the same year of the study.

Meanwhile, public housing, like all housing, is a major contributor to greenhouse gas emissions that are causing the climate emergency. We estimate that nationally public housing is responsible for about 5.6 million metric tons annually, the equivalent of 1.2 million cars used throughout each year. Through energy efficiency measures, electrification of building systems, and acquisition of energy from clean sources, these emissions would be brought to zero.

And residents of public housing suffer health harms caused by mold, lead contamination, poor indoor air quality, and unsafe temperatures. Studies have indicated that certain health conditions, such as asthma, are more prevalent in public housing compared to other households.[1] Substandard housing conditions can additionally contribute to mental health problems, engendering symptoms of chronic stress, depression, and hostility.

What should be done? How can we make the needed repairs while also transforming the country's public housing into comfortable, healthy, safe, zero-carbon, green housing? With constantly improving 21st century green technology, we can decarbonize and repair residential buildings currently managed by public housing agencies (PHAs). All over North America and Europe, public housing is being modernized with deep energy retrofits that slash carbon emissions and massively improve residents' quality of life. As tens of millions of Americans struggle with housing costs, especially young people, women, and people of color, and as carbon emissions threaten the very foundations of both the economy and our society, we face a generational opportunity and duty to tackle these problems in tandem.

We estimate that for $119 to $172 billion in green retrofits and capital repairs over ten years (roughly 1% of the cost of the Tax Cuts and Jobs Act of 2017, also known as the Trump Tax cut), it will be possible to conduct green upgrades of every public housing unit in the country, ramping up the pace of retrofits over the course of the decade as techniques and skills spread, in order to:

▶ Massively improve residents' health and comfort

▶ Cut public housing buildings' carbon footprint to zero

▶ Make public housing buildings resilient to extreme weather events

▶ Ensure each major public housing complex has community spaces to serve everyday needs and to be used as shelters during extreme weather like heat waves

▶ Upgrade community facilities on public housing land—like playgrounds—to serve public housing communities

Note: See the full report for all sources.

Photo by Luca Bravo on Unsplash

PART 1:
The Case for Comprehensive Green Retrofits to Public Housing

1.1 Core Principles: A Green New Deal for Public Housing

The Green New Deal for Public Housing Act, proposed by Rep. Alexandria Ocasio-Cortez and Sen. Bernie Sanders in November 2019, would undertake a decade of decarbonization and capital repairs to the country's public building stock (that is, homes managed by Public Housing Agencies (PHAs) as well as some tribal housing), tackling climate change and inequality at the same time.

As articulated in House Resolution 109, introduced by Rep. Alexandria Ocasio-Cortez and sponsored in the Senate by Sen. Ed Markey, the Green New Deal's core priorities include aggressive cuts to greenhouse gas emissions, widespread green job creation, and addressing inequalities of race and class. The resolution explicitly calls for direct green investment in frontline communities as a way to achieve these goals in the short term.

This targeted investment is often critiqued as an expensive and distracting add-on to decarbonization. But in fact, green social policy is a strategic lever to slash emissions directly by eliminating fossil fuel use and indirectly by growing the coalition for decarbonization.

The Green New Deal for Public Housing Act is a wise use of resources: the public sector already owns the buildings; they are in desperate need of maintenance already; green retrofits that slash carbon emissions, improve health and comfort, build community resiliency centers, and create jobs in neighborhoods with high unemployment, will together make huge improvements to people's everyday lives while building political support for more climate action. Indeed, we hope to soon develop legislation that extends these principles to other pieces of the low-income and affordable housing system.

Following the broad contours of the Green New Deal for Public Housing Act, this report estimates that with $119 to $172 billion of federal investment over ten years it would be possible to decarbonize more than one million units of the country's public housing stock—the equivalent of taking 1.2 million cars off the road every year. These same retrofits would eliminate lead, mold, and other health hazards that plague the nearly 2 million people who live in America's public housing and backfill the massive existing and accrual needs that have plagued existing public housing for decades. All this would create over 240,000 jobs per year, including tens of thousands of high-paying construction and maintenance jobs for public housing residents and nearby low-income workers.

This investment would cover both all necessary short-term and capital repairs *and* holistic building retrofits. Pairing green retrofits with immediate and deep capital repairs is the most efficient and cost-effective way to reach the twin goals of making public housing healthy, safe, and desirable for all residents and upgrading building systems to the highest 21st century green standards. Indeed, this investment will do even more—it will develop new labor skills and building upgrade techniques that will facilitate no-carbon green retrofits of other residences and commercial buildings across the country.

Public housing is found all over the country and is managed by local authorities. As there is a lack of comprehensive, national level data on public housing conditions countrywide, this report is largely concerned with outlining likely costs, likely economic and environmental benefits, mapping where the work would be done, and explaining some of the core tasks of green retrofits in different contexts. A more detailed analysis of a Green New Deal for NYCHA—New York's public housing authority, by far the largest in the country—can be found in our companion report, "A Green New Deal for NYCHA Communities."

In that report and this one, we imagine public housing developments and authorities not as isolated containers, but as integral parts of the country's housing system and local communities. Major investments in public housing will yield life-changing benefits for residents and communities in the form of new jobs, infrastructure, skills, technologies, community resiliency centers, and economic development.

At a time when we desperately need ways to lift up people and places who have suffered from decades of segregation and disinvestment, green investment in public housing—and by extension, in low-income workers who will secure new and often unionized green jobs—is a uniquely effective strategy to deliver multiple community benefits at once.

Meanwhile, all across the country, grassroots movements are battling to defend public housing from privatization and disinvestment and restore desperately needed funding. Public housing's underfunding has been unrelenting and brutal, undermining a model of non-market housing that has found success all over the world. In this extraordinarily hostile context, experts are asking what future—if any—public housing has in the United States.[2] A massive round of investment, as proposed by the Green New Deal for Public Housing Act would be a game-changer, saving public housing and moving the institution from a position of defensiveness and desperation to one of hope and innovation.

Groups like PUSH Buffalo have been especially far-sighted leaders in the struggle for climate-friendly, green retrofits. While PUSH and other groups have long recognized enduring problems in public housing management, they have also pushed against privatization, instead arguing for new models of democratic, non-market control of upgraded housing, such as through Community Land Trusts. While a thorough discussion of governance issues is beyond the scope of this report, we affirm that public housing should remain a public good and service and support a move to greater institutional power for public housing residents and other community stakeholders. In our view, unlocking desperately needed new funding to restore and upgrade public housing should end the pressure to privatize and start a new conversation about the best way to revitalize, organize, and hopefully expand our public housing, one of the country's greatest public assets.

Indeed, as housing scholar Peter Dreier wrote recently in *The American Prospect*, "The quest to provide what has come to be called 'affordable housing' in America is hobbled by one fundamental reality. Too much housing is in the market sector and too little is in a social sector permanently protected from rising prices."[3] (To be sure, we would also prefer greater market regulations to ensure reasonable prices.) For all its current problems, public housing in the US has provided bastions of stability and affordability while crises of eviction, foreclosure, and gentrification have proliferated throughout the private market.[4] The problem isn't that public housing exists in the United States, but that there is too little of it, and what there is has not received adequate investment and care. More public housing at higher quality would provide a true public option that would help restructure the entire

system to be higher quality and more affordable. As Dreier goes on to demonstrate, echoing many other scholars, cities like Vienna that have invested responsibly in social housing have seen extraordinarily high quality developments that have advanced innovative design and addressed social and environmental priorities.[5] Indeed, in Boston, Toronto, and many European cities,[6] social and public housing has been retrofitted and modernized to the highest standards of energy efficiency, furthering environmental goals while raising the quality of life for residents.[7]

In Bordeaux, France, a green public housing retrofit of the 530-unit Grand Parc complex recently won the European Union prize for contemporary architecture, the Mies van der Rohe award.[8] The prize reflected not just the genius of this particular retrofit, with its famous "winter garden" balcony extensions, but also the *accumulated skills* developed by the architectural firm Lacaton & Vassal, through retrofits performed on many buildings and complexes. In fact, Lacaton & Vassal became so efficient that in Bordeaux, residents were not even displaced for a day. With the Green New Deal for Public Housing Act, such an industry could arise and develop new techniques here in the United States, making unforeseeable contributions both to building technologies and aesthetics of public spaces.

Such an industry would not start from scratch. The United States has actually performed green public housing retrofits before. In cities like New York, affordable housing development has catalyzed new construction techniques for high quality energy efficient homes.[9] And pioneering architectural firms are developing the skills to retrofit existing public and affordable housing to the highest green standards. In Vermont, the Taylor Street mixed-income housing complex in Montpelier, and the Allard mixed-income senior housing complex in Burlington atop a net-zero transit center, exemplify energy-efficient, affordable housing projects.[10] And in Corona, Queens, Rep. Ocasio-Cortez recently helped open

a combined 67-unit senior center with attached pre-k children's center that was built to high standards of green, energy efficient construction.

The skills to develop and maintain low-cost, high-quality green housing are out there. With a Green New Deal, public housing funded directly by the public sector without indirect and inefficient tax breaks or public-private partnerships can build out and benefit from the country's 21st century green building economy. We still have the time and resources to transform the United States' public housing into beautiful homes that improve lives while combating climate change—creating a Green Homes Guarantee that people will fight to hold on to and improve over time.[11]

1.2 Public Housing Needs a Green New Deal

The current situation of national public housing is desperate. A Department of Housing and Urban Development (HUD) 2010 study estimated the capital needs deficit of the country's roughly 1.1 million public housing units. It estimated that at that time, the nation's public housing stock required $25.6 billion in capital repairs to address endemic conditions of ill repair, from peeling lead paint, to molding or rotting subflooring, to failing HVAC systems. **HUD estimated that there would be a total need for $89 billion worth of repairs and ongoing accrual costs in public housing over the 20 year timeframe to 2030**—assuming that the original repair needs were filled in an orderly fashion starting the same year of the study.[12]

Public housing, like all housing, is a major contributor to greenhouse gas emissions that are causing the climate emergency. Nearly one sixth of the country's total greenhouse gas emissions come from home energy use. Decarbonizing the residential sector is essential to

stabilizing the climate. To do that requires massively improving insulation and other energy efficiency measures, electrifying all systems, and powering those systems with exclusively clean, no-carbon energy. These and other deep energy retrofits must be paired with capital repairs to efficiently to make housing safe, healthy, and comfortable. The 2010 study estimated that just over $4.1 billion of the total $25.6 billion in repairs would be needed just to meet extant energy standards and replace outdated energy-consuming equipment with contemporary more energy-efficient versions—not to produce deep energy retrofits or decarbonize. The ambitions laid out in this report (and thus the estimated costs) are greater, in order to establish a new, lasting, modern, and climate-friendly foundation for public housing in the decades ahead.

To make headway on decarbonizing the country's building stock, then, it is strategic to first leverage investments in already public assets to develop the skills and workforce to make all the country's homes comfortable, green, and zero-carbon. Decarbonizing public housing is an essential piece of the broader puzzle.

We estimate that nationally, public housing is responsible for about 5.6 million metric tons of carbon emissions annually, the equivalent of that generated by 1.2 million cars. Through energy efficiency measures, electrification of building systems, and acquisition of energy from clean sources, these emissions would be brought to zero.

And residents of public housing suffer health harms caused by mold, lead contamination, poor indoor air quality, and unsafe temperatures. Studies have indicated that certain health conditions, such as asthma, are more prevalent in public housing compared to other households.[13] Substandard housing conditions can additionally contribute to mental health problems, engendering symptoms of chronic stress, depression, and hostility.[14]

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▶ Upgrade community facilities on public housing land—like playgrounds—to serve public housing communities

We also emphasize in this report that local context is essential to the particular forms that green retrofits must take. In Section 5 on Indian Housing and Section 6 on tailoring reotrifts, we discuss some of the particular factors that green retrofits must take into account.

1.3 Summary of Benefits

▶ **Invest \$119 to \$172 billion in green retrofits that include all needed capital repairs, vastly improved health, safety and comfort, and eliminate carbon emissions.** This would hugely improve the living conditions of nearly 2 million people, living in roughly 1 million units.[15]

▶ **Create up to 240,723 jobs per year nationally across multiple sectors**, thanks to the injection of billions of dollars into the 21st century green retrofit economy. (For all jobs and economic projections, see Appendix below.)

▶ **Directly create from 22,297 to 35,755 career-track, high-paying jobs per year in skilled maintenance and construction for public housing residents**, with average wages depending on state. As examples, average wages in construction are \$69,992 in California, \$61,828 in Colorado, and \$61,620 in Georgia. These are comparable to early-career union rates.[16]

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▶ **Create constructions jobs that cross partisan divides.** Because public housing is widespread across the country's political divides, these investments would create more skilled construction and maintenance jobs per year for public housing residents in red states (up to 17,489) than blue states (up to 9,428), with party affiliation based on which party won the most votes in the 2016 presidential election. At the congressional district level, however, there would be more jobs for public housing residents in blue districts (up to 14,224) than red (up to 12,168), with party affiliation based on the 2018 midterm congressional election.

▶ **Reduce annual carbon emissions by roughly 5.6 million metric tons annually compared to recent years, the equivalent of taking over 1.2 million cars off the road.** We achieve this through electrification, increased energy efficiency, renewable energy purchase and solar panel installation, and removal of fossil fuels from building systems.[17]

▶ **Reduce public housing water bills by up to 30% per year, or \$97 million.[18]**

▶ **Reduce public housing energy bills by up to 70% per year, or \$613 million dollars.[19]**

PART 2:
The Economics of a Green New Deal for Public Housing Communities

2.1 Affordability of Fixing Public Housing

For years the federal government has renounced over $70 billion in tax revenues from the mortgage interest tax deduction (MID), which disproportionately assists middle and upper class white households. In 2015 alone, federal expenditures toward homeownership, primarily through the MID, were nearly 5 times all expenditures on affordable rental housing.[20] As the Urban Institute reports, "high-income households benefit vastly more from the MID than lower-income households, in dollar terms." Due to recent tax policy changes, the cost of the MID is now projected to be slightly under $30 billion per year.[21] Even at that level, this is a highly inefficient use of public funds for housing support.

In contrast, public housing assists low-income people, and disproportionately people of color, through direct provision of housing. (We also support substantially increasing support to other affordable housing programs, considering there are 3 low-income households eligible for rental assistance for every one that receives it,[22] although this is beyond the scope of the Green New Deal for Public Housing Act and our report.)

Even a total, one-time, ten-year commitment of up to $172 billion to repair and upgrade public housing would cost far less than the MID, and just over a tenth of President Trump's $1.5 trillion tax cut (projected over ten years).

What is more, the federal government has substantial fiscal space for maneuver, thanks to historically low interest rates and persistent, low inflation rates. So long as the public investments are productive (ie, spent usefully on concretely beneficial projects, such as public housing retrofits), we have the capacity to use general government revenues and debt financing to pursue such a high priority as part of the broader Green New Deal effort to stave off climate emergency.[23] We could also use revenues from new taxes on wealth, investment income, carbon, or other sources, especially given how little total tax revenue the US government collects compared to other industrialized nations.

Meanwhile, existing programs to address public housing's crisis, namely the Rental Assistance Demonstration, merely move funding from other housing programs to public housing on condition of privatization, while failing to demonstrate the promised results.[24]

Overall, the issue is not lack of funds but a federal unwillingness to adequately fund public housing. If we can muster the political power, we already have the necessary resources to save public housing and use green reotrifts as a lever to improve the lives of all residents of public housing and surrounding communities—while also slashing carbon pollution and developing a 21st century green buildings economy.

2.2 New Green Jobs Across America

The level of investment proposed in this report—$117 to $172 billion over ten years—will also create up to 240,000 jobs per year, including tens of thousands of skilled maintenance and construction jobs for public housing residents and low-income workers.[25]

This program would also be an immediate boost to the domestic appliance manufacturing industry and directly create jobs in American manufacturing and supplier industries. We estimate that purchasing efficient, modern, electric induction stoves for each unit, and efficient fridges and low-flow toilets for three quarters of units (as some upgrades are already under way), would create nearly 8000 total jobs, including over 2100 manufacturing jobs, over the course of ten years.[26] As with jobs in retrofits, we anticipate that these jobs wouldn't simply disappear afterwards but become a strong foundation for the growing industries of a new, green economy. Read more about the public housing's history of green appliance innovation in our companion report, "A Green New Deal for NYCHA Communities."

In terms of construction work, the Green New Deal for Public Housing Act would reform HUD's Section 3 regulations to increase the training and hiring of public housing residents and other low-income workers to work on green retrofits for public housing. Based on the guidelines in the bill, we estimate that roughly 75% of new jobs in construction and maintenance would go to Section 3 eligible workers over the course of ten years.

For simplicity, we assume that half (37.5% of total new construction and maintenance jobs) would come from NYCHA residents working on their complexes, and another half would be low-income workers throughout the city. In the district profiles further down this report, we estimate the number of NYCHA resident jobs created per congressional district (see Table 2 on the next page).

In the online companion to this report, at www. dataforprogress.org, we provide interactive maps and tables that allow viewers to see exactly where public housing units all across the country are located and to inspect tables that show numbers of units, estimated per-unit retrofit cost (based on regional climate tendencies), estimated numbers of local jobs created (at the district, metro area, and state level).

Note that jobs created do not correspond evenly to number of units, because both wages and average retrofit costs as estimated by HUD vary by region.[27]

In this report, we simply include some samples of this data. In the tables in this section of the report, we focus on on-site construction and maintenance jobs, both for public housing residents, and overall jobs. We report slightly different information based on the geographic unit, showing more granular spatial data at the congressional district level (ie, number of buildings and units of housing), including both public housing and total on-site construction jobs for metro and state levels, and noting political representation by party for district and state.

Public housing characteristics and locations in these tables are based on HUD data,[28] and job numbers are based on our projections as detailed in our Appendix.

Table 1. **Top 20 Congressional Districts, by Number of Skilled Construction and Maintenance Jobs Created Per Year (excluding New York City)**

Democrat Republican

DISTRICT	STATE	MAIN CITIES	BUILDINGS	HOUSING UNITS	AVERAGE WAGES	REGION	JOBS FOR PH RESIDENTS PER YEAR (LOW-END COST ESTIMATE)	JOBS FOR PH RESIDENTS PER YEAR (HIGH-END COST ESTIMATE)
PR98[29]	PR	NA	290	53,158	24492	Puerto Rico	2,517	4,406
AL07	AL	Selma and others	67	9,535	53820	South	207	363
OH11	OH	Cleveland and Akron	37	9,595	58916	Midwest	175	306
PA03	PA	Philadelphia	52	9,084	65208	Northeast	175	306
NJ08	NJ	Newark	45	9,343	70460	Northeast	167	292
AL04	AL	Several	60	6,983	53820	South	152	265
MA7	MA	Boston	62	9,405	80756	Northeast	146	256
FL24	FL	Miami	26	6,286	51116	South	1440	252
AR01	AR	Several	48	5,413	45812	South	138	242
DC98	DC	Washington, DC	57	8,249	70824	South	136	238
NJ10	NJ	Newark and Orange	48	7,473	70460	Northeast	133	233
IN01	IN	Gary	22	6,636	56004	Midwest	127	223
IL07	IL	Chicago	64	8,312	70252	Midwest	127	222
IL12	IL	Several	58	7,746	70252	Midwest	118	207
VA03	VA	Several	41	5,749	57772	South	116	204
WA07	WA	Seattle	44	5,016	64532	West	116	203
PA08	PA	Several	27	5,946	65208	Northeast	115	201
NC01	NC	Several	40	5,120	54808	South	109	191
GA02	GA	Several	48	5,651	61620	South	107	188

Red indicates congressional district represented by a Republican in 2019, blue by a Democrat. Neither Puerto Rico nor Washington, DC, is represented by a voting congressperson in the U.S. House of Representatives.

The above table shows the 20 congressional districts, outside New York City, with the largest public housing stocks. Public housing is located all across the country, in urban and rural places, and in Democratic- and Republican-voting districts, and the benefits of a Green New Deal for Public Housing would be widely distributed through these regions.

As shown in table 2 below, Democratic districts would have more jobs for public housing residents, but by a relatively small margin.

Table 2. **Skilled Construction and Maintenance Jobs Per Year for Public Housing Residents in Democratic and Republical Districts (excluding New York)**

🟦	Democratic Districts Low Cost Estimate: Jobs for Public Housing Residents	8,127
🟦	Democratic Districts High Cost Estimate: Jobs for Public Housing Residents	14,224
🟥	Republican Districts Low Cost Estimate: Jobs for Public Housing Residents	6,059
🟥	Republican Districts High Cost Estimate: Jobs for Public Housing Residents	12,168

As shown in Table 3 below, aggregating districts into metropolitan areas gives a slightly different picture of the distribution of public housing residents, investment locations, and jobs likely to be created by the Green New Public Housing Act.

Table 3. **Top 20 Metropolitan areas, by Number of Skilled Construction and Maintenance Jobs Created Per Year (excluding New York City)**

ESTIMATION AREA	PUBLIC HOUSING UNITS	AVERAGE WAGES	JOBS FOR PH RESIDENTS PER YEAR (LOW)	JOBS FOR PH RESIDENTS PER YEAR (HIGH)	TOTAL ESTIMATED ON-SITE JOBS (LOW)	TOTAL ESTIMATED ON-SITE JOBS (HIGH)
San Juan-Carolina-Caguas, PR	31,419	24,492	1,488	2,604	3,968	6,944
Boston-Cambridge-Newton, MA-NH	22,689	80,756	353	618	941	1,648
Chicago-Naperville-Elgin, IL-IN-WI	20,013	70,252	306	535	816	1,427
Ponce, PR	6,324	24,492	299	524	797	1,397
Miami-Fort Lauderdale-West Palm Beach, FL	12,126	51,116	277	485	739	1,293
Pittsburgh, PA	14,029	65,208	270	473	720	1,261
Los Angeles-Long Beach-Anaheim, CA	9,973	69,992	213	373	568	995
Seattle-Tacoma-Bellevue, WA	9,103	64,532	211	369	563	984

Table 3. **Top 20 Metropolitan areas, by Number of Skilled Construction and Maintenance Jobs Created Per Year (excluding New York City) (Cont'd)**

ESTIMATION AREA	PUBLIC HOUSING UNITS	AVERAGE WAGES	JOBS FOR PH RESIDENTS PER YEAR (LOW)	JOBS FOR PH RESIDENTS PER YEAR (HIGH)	TOTAL ESTIMATED ON-SITE JOBS (LOW)	TOTAL ESTIMATED ON-SITE JOBS (HIGH)
Cleveland-Elyria, OH	10,598	58,916	193	338	515	901
Minneapolis-St. Paul-Bloomington, MN-WI	11,759	66,612	189	332	504	885
Birmingham-Hoover, AL	7,863	53,820	171	299	456	797
Mayagüez, PR	3,614	24,492	171	300	456	800
Baltimore-Columbia-Towson, MD	9,279	64,636	168	294	448	784
Aguadilla-Isabela, PR	3,553	24,492	168	294	448	784
Atlanta-Sandy Springs-Roswell, GA	8,196	61,620	156	272	416	725
Detroit-Warren-Dearborn, MI	8,655	60,008	155	271	413	723
Washington-Arlington-Alexandria, DC-VA-MD-WV	8,249	70,824	136	238	363	635
San Francisco-Oakland-Hayward, CA	5,971	69,992	128	223	341	595
Virginia Beach-Norfolk-Newport News, VA-NC	6,263	57,772	127	222	339	592
San Antonio-New Braunfels, TX	6,797	66,664	119	209	317	557

By aggregating public housing by metro area, we see that most US public housing is located in large metropolitan areas, even as there are significant concentrations in rural districts (as shown in Table 1 above).

Table 4. **Top 20 States, by Number of Skilled Construction and Maintenance Jobs Per Year Created (excluding New York City)**

🟦 Democrat   🟥 Republican

STATE	AVERAGE CONSTRUCTION WAGES	HOUSING UNITS	JOBS FOR PH RESIDENTS PER YEAR (LOW-END COST ESTIMATE)	TOTAL JOBS (LOW-END COST ESTIMATE)	JOBS FOR PH RESIDENTS PER YEAR (HIGH-END COST ESTIMATE)	TOTAL JOBS (HIGH-END COST ESTIMATE)
PR	24,492	53,158	2,517	6,710	4,406	11,746
PA	65,208	59,053	1,140	3,039	1,993	5,313
TX	66,664	46,949	825	2,199	1,441	3,842
OH	58,916	40,987	748	1,994	ic1,307	3,484
AL	53,820	33,723	734	1,957	1,282	3,418
IL	70,252	46,016	705	1,880	1,230	3,279
FL	51,116	29,892	684	1,824	1,196	3,189
CA	69,992	28,690	614	1,637	1,074	2,863
GA	61,620	32,130	609	1,624	1,067	2,845
NJ	70,460	31,341	558	1,488	978	2,607
NC	54,808	26,203	559	1,490	977	2,605
TN	54,860	25,867	551	1,469	965	2,573
MA	80,756	33,928	527	1,405	923	2,461
KY	52,624	22,587	502	1,338	877	2,338
NY	72,436	28,698	497	1,325	872	2,325
MI	60,008	21,104	379	1,010	661	1,762
LA	64,584	18,775	338	901	596	1,589
MN	66,612	20,680	334	890	583	1,554
VA	57,772	16,085	325	866	570	1,520

Red indicates state electoral college votes went to Trump in 2016, blue to Clinton.

Overall, public housing is widespread across the country's political divides, with jobs dispersed through the country along non-partisan lines. Since there can be a misconception that public housing is a "blue" issue that only affects "inner cities," we emphasize here that public housing is found in rural, suburban, and urban places, in red-voting and blue-voting places. Countrywide, over a third of public housing residents are white. As shown in Part 3, below, some of the districts with the highest numbers of public housing units amidst white communities are rural in areas outside big cities. Overall, our modeling finds that green investments would create more skilled construction and maintenance jobs per year for public housing residents in red states than blue states, with party affiliation based on which party won the most votes in the 2016 presidential election, as shown in Tables 5 and 6. At the congressional district level, however, there would be more jobs for public housing residents in blue districts than red, with party affiliation based on the 2018 midterm congressional election, as shown in Table 4 above. (Although these tables exclude New York City, which is covered in our companion report, most construction jobs are still projected to go to red states even after adding including on-site maintenance and construction jobs in New York, which we estimate at 4,342 per year.)

Table 5. **Skilled Construction and Maintenance Jobs per year for Public Housing Residents in Democratic and Republical States (excluding New York), based on 2016 Electoral College Results**

	Democratic States Low Cost Estimate: PH Resident Construction and Maintenance Jobs	5,737
	Democratic States High Cost Estimate: PH Resident Construction and Maintenance Jobs	9,428
	Republican States Low Cost Estimate: PH Resident Construction and Maintenance Jobs	10,000
	Republican States High Cost Estimate: PH Resident Construction and Maintenance Jobs	17,489

Table 6. **Total Skilled Construction and Maintenance Jobs per year in Democratic and Republican States (excluding New York), based on 2016 Electoral College Results**

	Democratic States Low Cost Estimate: Total Construction and Maintenance Jobs	14,365
	Democratic States High Cost Estimate: Total Construction and Maintenance Jobs	25,237
	Republican States Low Cost Estimate: Total Construction and Maintenance Jobs	26,666
	Republican States High Cost Estimate: Total Construction and Maintenance Jobs	46,636

PART 3:

Locating Public Housing Communities: Exemplary Metro Areas and Rural Communities

As shown by the data above, public housing is found all over the country, in rural and urban areas, and in every region. At our website, you will be able to consult a dynamic national map of all public housing units in the United States. Here, we present maps and tables that show some of the diversity of housing across regions and spaces. We highlight three rural districts, two with Republican representatives and one with a Democratic representative. And we show metro areas in the West, Midwest, South, and Northeast. We pair these maps with tables that provide information about public housing characteristics in each of the pictured districts that have public housing.

The maps give a sense of the demographic contexts of public housing communities by showing levels of unemployment and percentage of the population that is white. While in many cases, the neglect of public housing has a lot to do with the systematic underinvestment in urban communities of color, that is not the whole story. Many white neighborhoods, and many rural communities, also feature public housing in desperate need of green retrofits. This is a story about the whole country.

The maps also indicate how much of a challenge rising sea levels caused by climate change will be in many cities. We show map layers based on the National Oceanic and Atmospheric Administration projections of 3 feet, 7 feet,

and 10 feet of sea-level rise. Rapid carbon emissions reductions could limit global warming to 1.5 or 2 degrees Celsius, and potentially limit sea-level rise to 3 feet or slightly over by the end of the century. Still, oceans would likely continue rising for millennia—the main question being how fast and how high.[30] At higher levels of warming, 3 to 4 degrees Celsius (the trajectory we are currently on) sea levels could easily rise 7 feet by the end of the century, reaching even 10 feet by 2100 or shortly thereafter. We included this full spectrum of sea level rise because it is important to visualize the full range of possible outcomes.

But perhaps more importantly, the higher range of rising tides is also a proxy for flood risk, which will increase along with rising seas. Even if we limit sea-level rise to below 10 feet, the areas in that zone will still become more vulnerable to periodic flooding. In a forthcoming report, we will say more about measures that are needed to adapt to this change, including making the case for building much more public housing. Here, we note (as we did in our New York City-focused report) that techniques like wet-proofing ground-floors of large complexes are good first steps. We also take note of how grim the situation looks for Miami. In such places, we absolutely need to retrofit housing immediately to bring residents' situations up to decent standards. We must also plan new social housing in places that are less at risk, for the changes that are virtually inevitable.
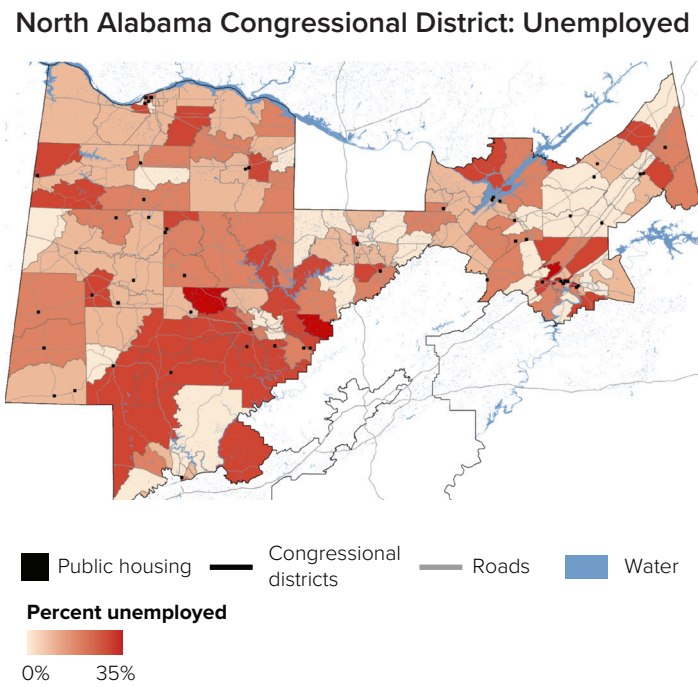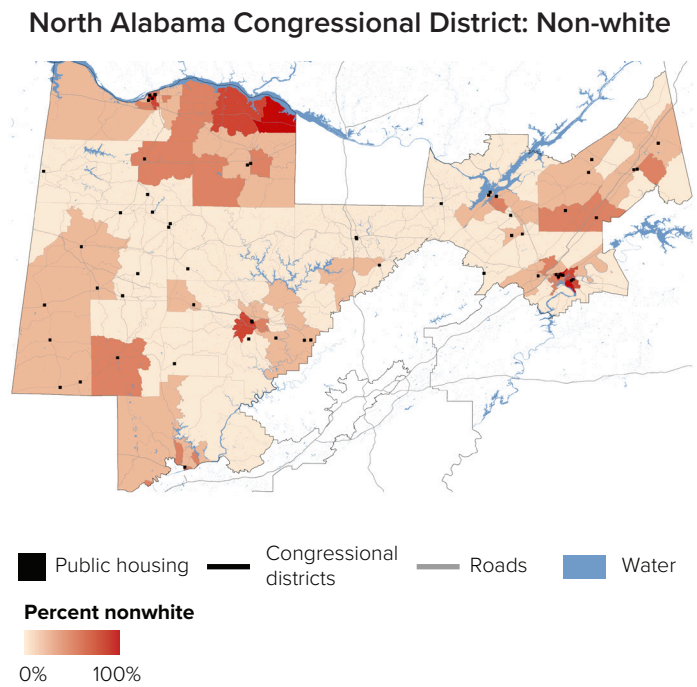
A note on data

The maps and data below estimate the impacts of different levels of sea level rise with scenarios produced by NOAA.[31] For inland locations, annual risk of flooding was taken from the National Flood Hazard Layer geospatial database maintained by FEMA in support of the National Flood Insurance Program.[32] The location and characteristics of all public housing are provided by the U.S. Department of Housing and Urban Development Open Data program.[33] Census tract-level estimates of unemployment, poverty, and racial composition are provided by the Census Bureau based on the 2013-17 American Community Survey 5-year pooled data.[34]

AL 04 North Alabama Congressional District

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).
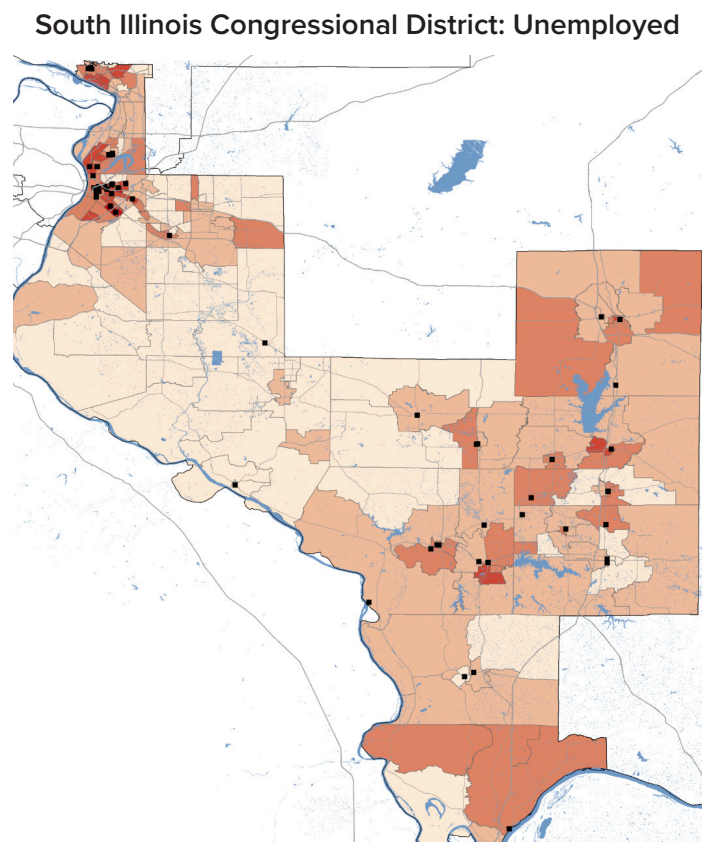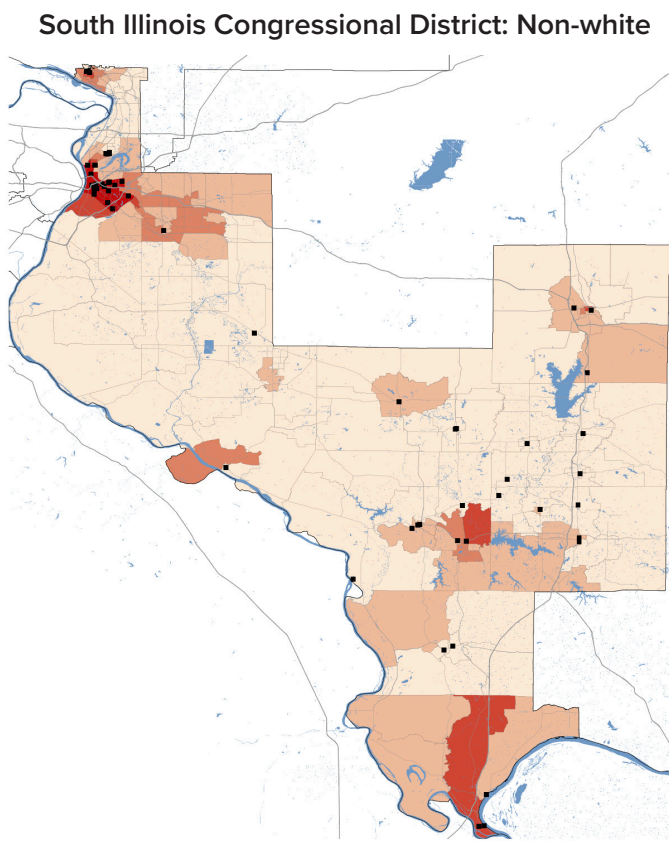
Estimation area	Ph units	Average wages	Jobs for ph residents per year (low)	Jobs for ph residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
AL04	6,983	53,820	152	265	405	708	Republican

North Alabama Congressional District: Non-white

| Public housing | Congressional districts | Roads | Water |

Percent nonwhite

0%   100%

North Alabama Congressional District: Unemployed

| Public housing | Congressional districts | Roads | Water |

Percent unemployed

0%   35%

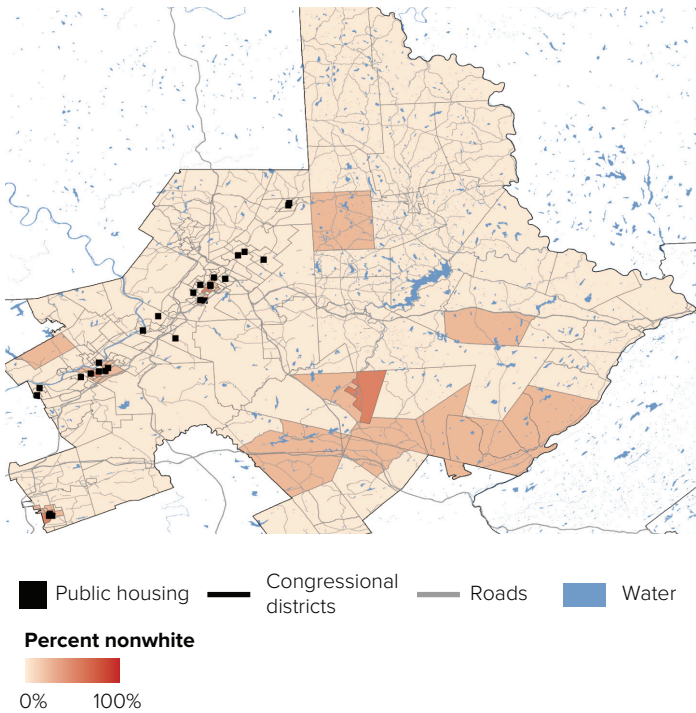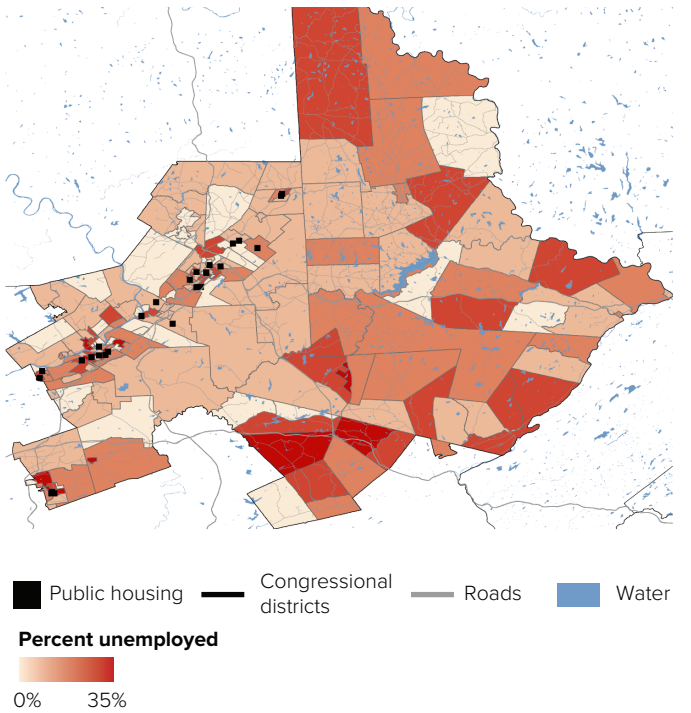# IL 12: South Illinois Congressional District

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
IL12	7,746	70,252	118	207	315	552	Republican

South Illinois Congressional District: Non-white

- Public housing
- Congressional districts
- Roads
- Water

Percent nonwhite
0% — 100%

South Illinois Congressional District: Unemployed

- Public housing
- Congressional districts
- Roads
- Water

Percent unemployed
0% — 35%

PA 08 Northeastern Pennsylvania Congressional District

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
PA08	5,946	65,208	115	201	307	535	Democrat

Northeastern Pennsylvania Congressional District: Non-white

Public housing Congressional districts Roads Water

Percent nonwhite

0%   100%

Northeastern Pennsylvania Congressional District: Unemployed

Public housing Congressional districts Roads Water
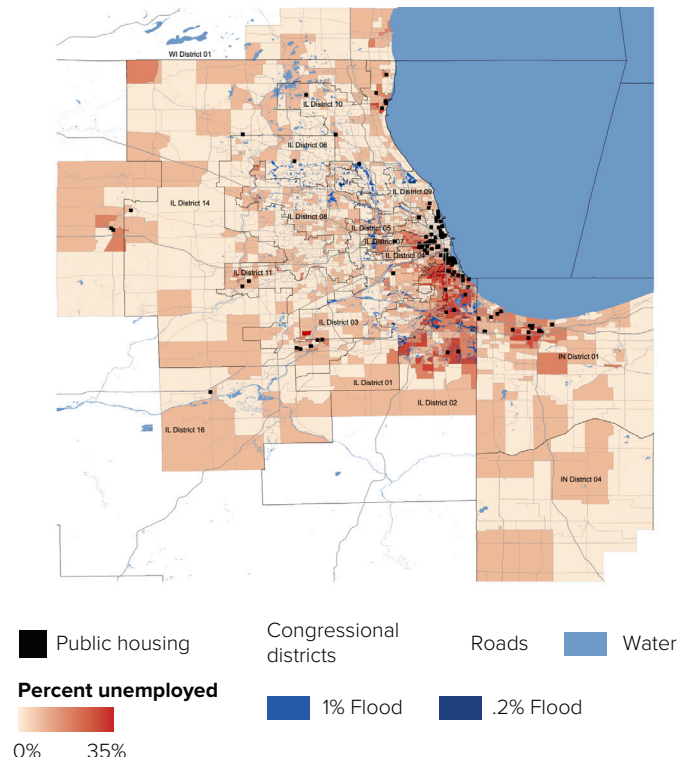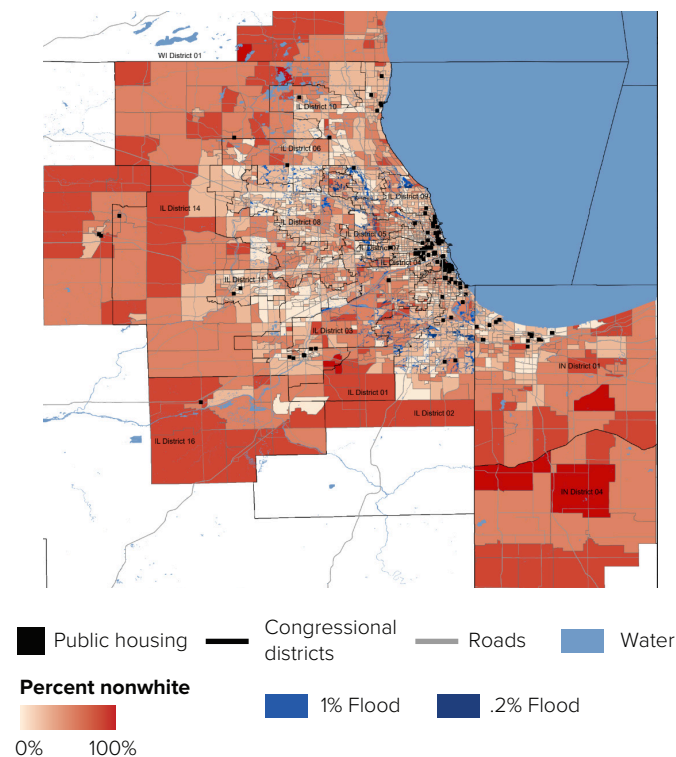
Percent unemployed

0%   35%

Chicago Metrpolitan Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
IL01	952	70,252	15	25	40	68	Democrat
IL02	3,481	70,252	53	93	141	248	Democrat
IL03	182	70,252	3	5	8	13	Democrat
IL04	362	70,252	6	10	16	26	Democrat
IL05	2,335	70,252	36	62	96	166	Democrat
IL06	67	70,252	1	2	3	5	Democrat
IL07	8,312	70,252	127	222	339	593	Democrat
IL09	1,699	70,252	26	45	69	121	Democrat
IL10	1,081	70,252	17	29	45	77	Democrat
IL11	1,377	70,252	21	37	56	98	Democrat
IL14	122	70,252	2	3	5	9	Democrat
IL16	2,157	70,252	33	58	88	154	Republican
IN01	6,636	56,004	127	223	339	593	Democrat
IN04	550	56,004	11	18	29	49	Republican
TOTAL	29313	66,132	478	832	1274	2220	

Chicago Metropolitan Area: Non-white

Public housing — Congressional districts — Roads — Water

Percent nonwhite 0% — 100%

1% Flood — .2% Flood

Chicago Metropolitan Area: Unemployed

Public housing — Congressional districts — Roads — Water

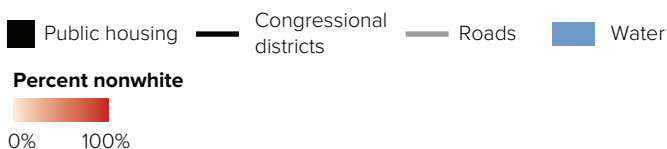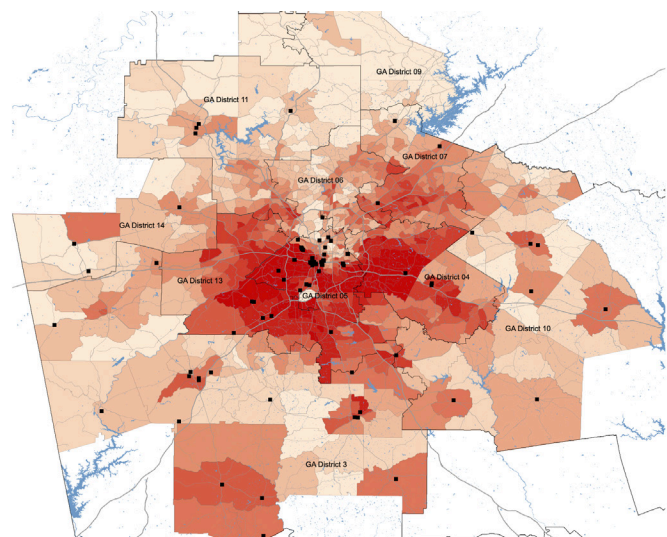**Percent unemployed** 0% — 35%

1% Flood — .2% Flood
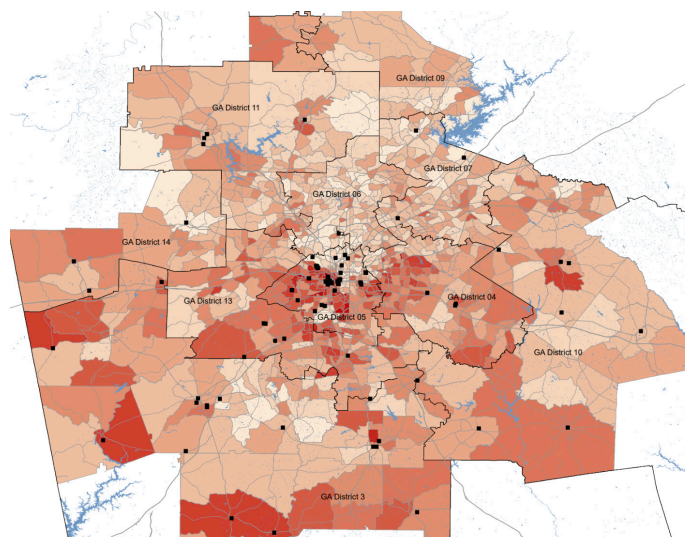
Greater Atlanta Metro Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
GA03	2,379	61,620	45	79	120	211	Republican
GA04	364	61,620	7	12	19	32	Democrat
GA05	4,468	61,620	85	148	227	396	Democrat
GA07	280	61,620	5	9	13	25	Republican
GA09	1,258	61,620	24	42	64	111	Republican
GA10	3,304	61,620	63	110	168	293	Republican
GA11	510	61,620	10	17	27	45	Republican
GA13	231	61,620	4	8	11	20	Democrat
GA14	1,960	61,620	37	65	99	174	Republican
TOTAL	**14,754**	**61,620**	**280**	**490**	**748**	**1307**	

Greater Atlanta Metro Area: Non-white

Public housing   Congressional districts   Roads   Water

Percent nonwhite

0%   100%

Greater Atlanta Metro Area: Unemployed

Public housing   Congressional districts   Roads   Water
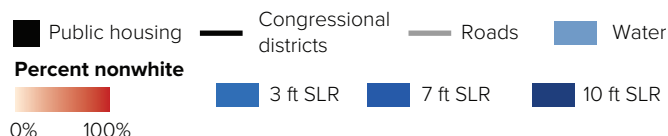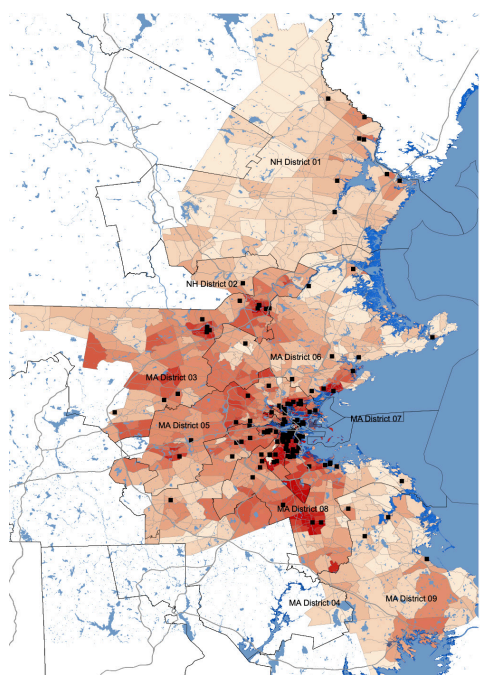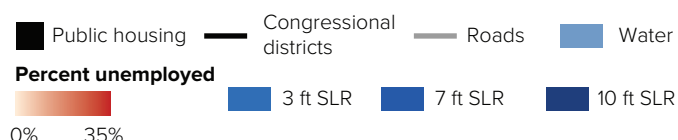
Percent unemployed

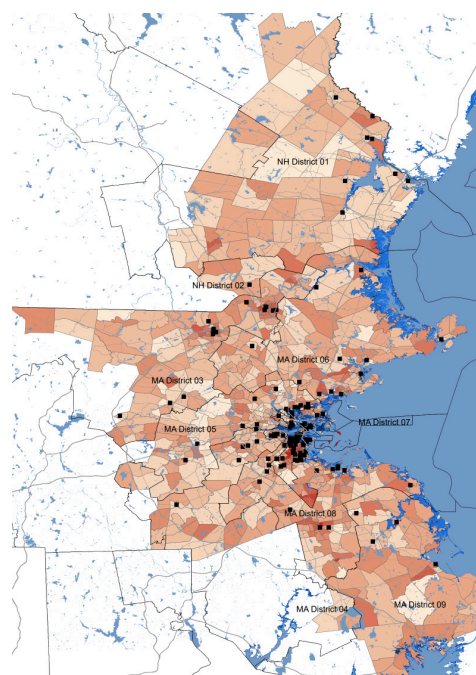0%   35%

Greater Boston Metropolitan Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
MA03	3,256	80,756	51	89	136	236	Democrat
MA04	2,281	80,756	35	62	93	166	Democrat
MA05	2,943	80,756	46	80	123	214	Democrat
MA06	1,230	80,756	19	33	51	89	Democrat
MA07	9,405	80,756	146	256	389	683	Democrat
MA08	4,900	80,756	76	133	203	356	Democrat
MA09	3,653	80,756	57	99	152	265	Democrat
NH01	2,520	59,436	53	93	141	249	Democrat
NH02	1,399	59,436	30	52	80	138	Democrat
TOTAL	**31,587**	**77,312**	**513**	**897**	**1368**	**2396**	

Greater Boston Metropolitan Area: Non-white

Public housing · Congressional districts · Roads · Water
Percent nonwhite 0% — 100%
3 ft SLR · 7 ft SLR · 10 ft SLR

Greater Boston Metropolitan Area: Unemployed

Public housing · Congressional districts · Roads · Water
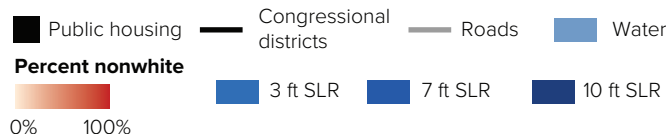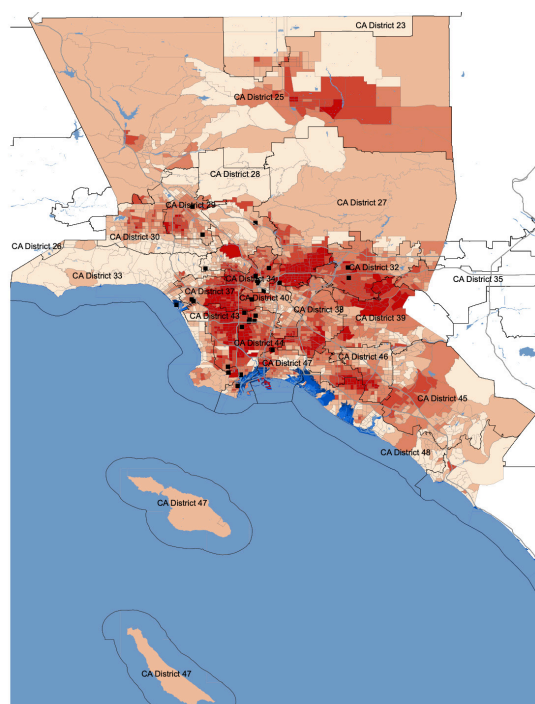Percent unemployed 0% — 35%
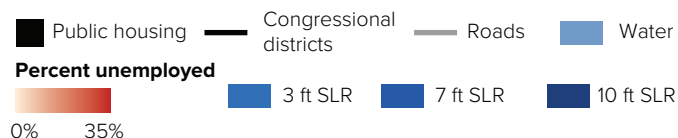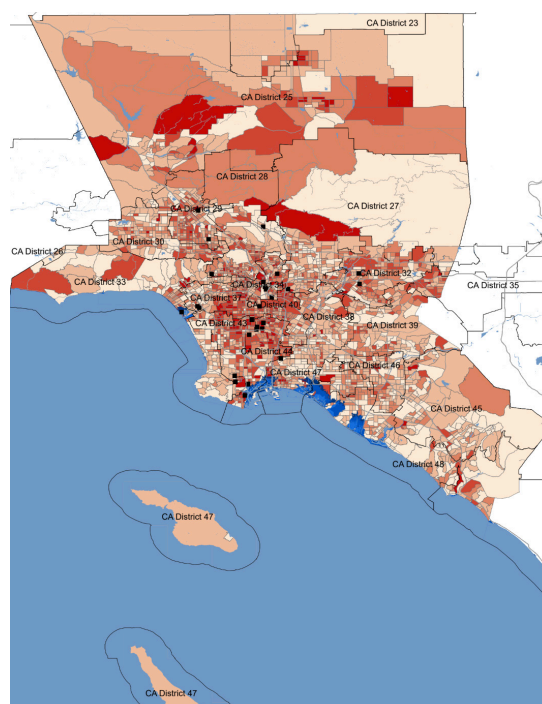3 ft SLR · 7 ft SLR · 10 ft SLR

Greater Los Angeles Metro Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
CA23	111	69,992	2	4	5	11	Republican
CA26	1,313	69,992	28	49	75	131	Democrat
CA28	543	69,992	12	20	32	54	Democrat
CA29	503	69,992	11	19	29	50	Democrat
CA32	275	69,992	6	10	16	27	Democrat
CA33	224	69,992	5	8	13	22	Democrat
CA34	1,961	69,992	42	73	112	196	Democrat
CA37	631	69,992	13	24	35	63	Democrat
CA40	1,164	69,992	25	44	67	116	Democrat
CA43	727	69,992	16	27	43	72	Democrat
CA44	3,233	69,992	69	121	184	322	Democrat
CA47	712	69,992	15	27	40	71	Democrat
TOTAL	**11397**		**244**	**426**	**651**	**1135**	

Greater Los Angeles Metro Area: Non-white

Public housing · Congressional districts · Roads · Water
Percent nonwhite 0% — 100%
3 ft SLR · 7 ft SLR · 10 ft SLR

Greater Los Angeles Metro Area: Unemployed

Public housing · Congressional districts · Roads · Water
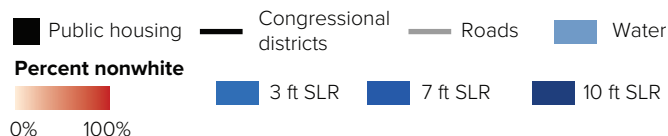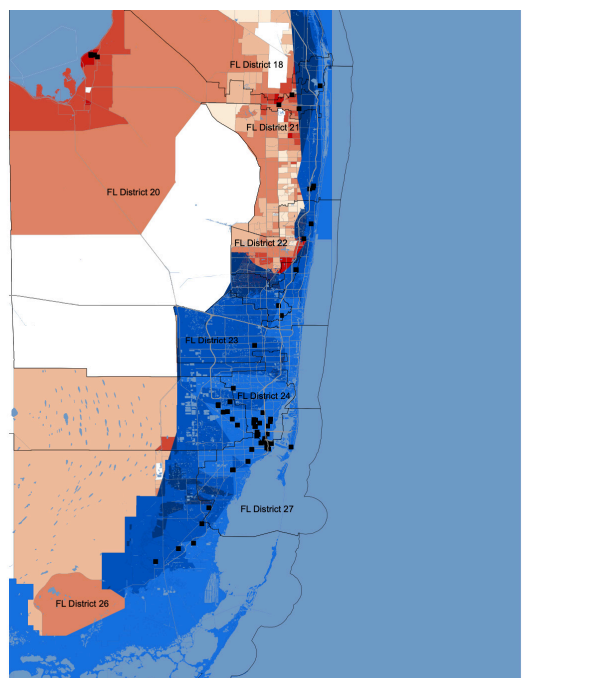Percent unemployed 0% — 35%
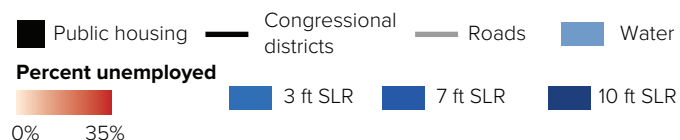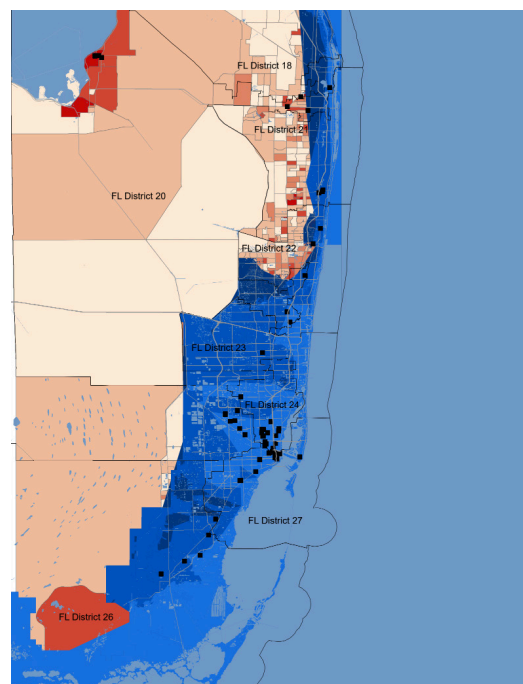3 ft SLR · 7 ft SLR · 10 ft SLR

Greater Miami Metro Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
FL18	1,188	51,116	27	48	72	127	Republican
FL20	873	51,116	20	35	53	93	Democrat
FL21	9	51,116	0	0	0	1	Democrat
FL22	195	51,116	4	8	11	21	Democrat
FL23	120	51,116	3	5	8	13	Democrat
FL24	6,286	51,116	144	252	384	671	Democrat
FL25	1,117	51,116	26	45	69	119	Republican
FL26	1,921	51,116	44	77	117	205	Democrat
FL27	1,949	51,116	45	78	120	208	Democrat
TOTAL	**13,658**	**51,116**	**313**	**548**	**834**	**1458**	

Greater Miami Metro Area: Non-white

Public housing — Congressional districts — Roads — Water

Percent nonwhite
0% — 100%

3 ft SLR — 7 ft SLR — 10 ft SLR

Greater Miami Metro Area: Unemployed

Public housing — Congressional districts — Roads — Water

Percent unemployed
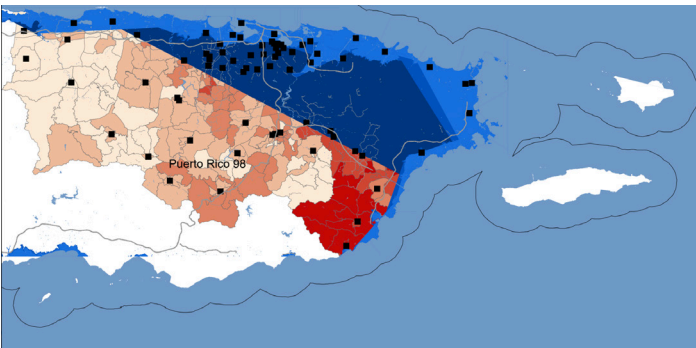0% — 35%

3 ft SLR — 7 ft SLR — 10 ft SLR
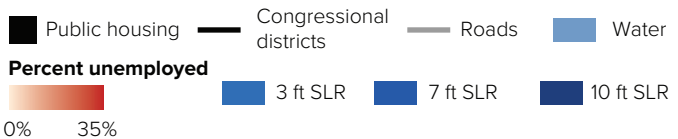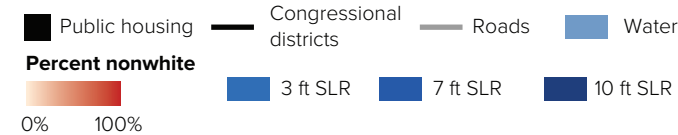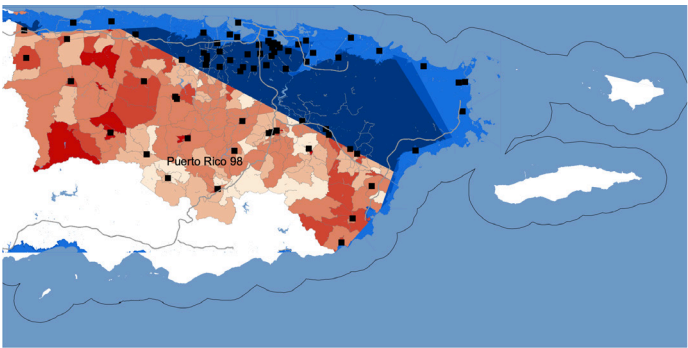
Greater San Juan Metro Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
PR98	53,158	24,492	2,517	4,406	6,712	11,748	NA

Greater San Juan Metro Area: Non-white

Public housing   Congressional districts   Roads   Water

Percent nonwhite

0%   100%

3 ft SLR   7 ft SLR   10 ft SLR

Greater San Juan Metro Area: Unemployed

Public housing   Congressional districts   Roads   Water

Percent unemployed
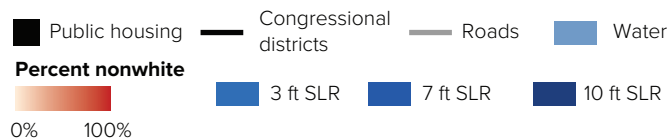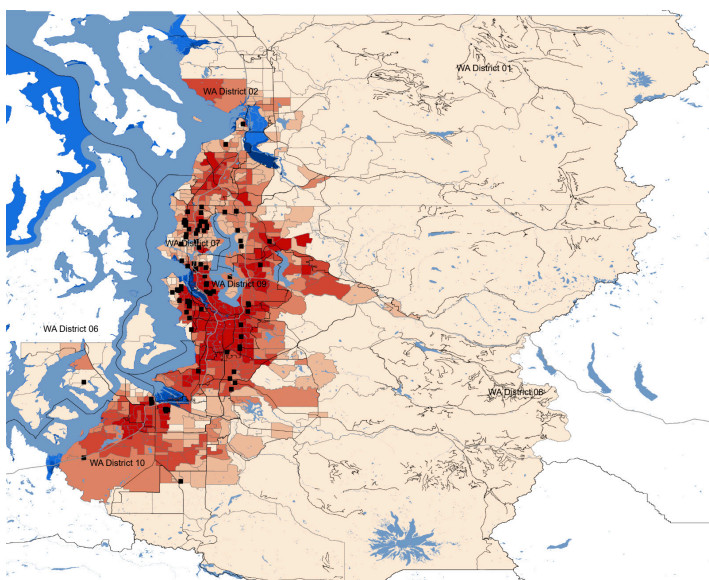
0%   35%

3 ft SLR   7 ft SLR   10 ft SLR
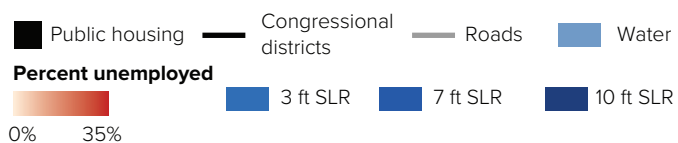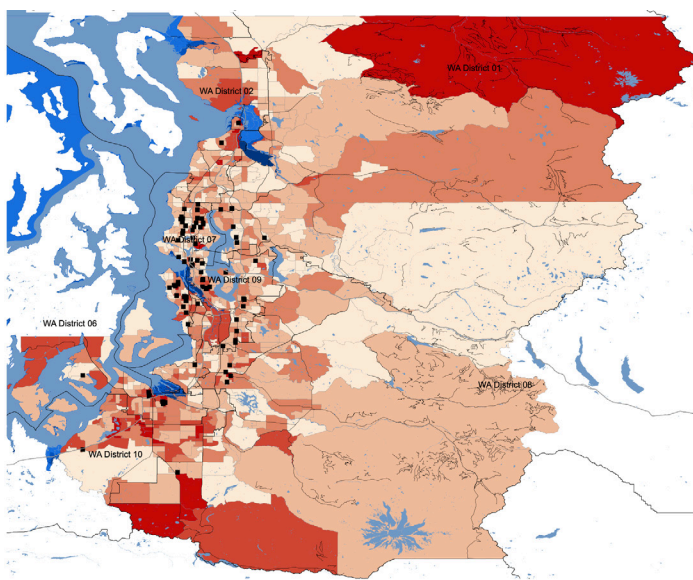
Greater Seattle Metro Area

CONGRESSIONAL DISTRICTS: New Construction and Maintenance Jobs, Per Year, based on Low and High End of Federal Investment in Green New Deal for Public Housing Act ($119 to $172 billion over ten years).

Estimation area	PH units	Average wages	Jobs for PH residents per year (low)	Jobs for PH residents per year (high)	Total estimated on-site construction & maintenance jobs (low)	Total estimated on-site construction & maintenance jobs (high)	Party (2018 mid-term election)
WA01	310	64,532	7	13	19	34	Democrat
WA02	1,093	64,532	25	44	67	118	Democrat
WA06	637	64,532	15	26	40	69	Democrat
WA07	5,016	64,532	116	203	309	542	Democrat
WA08	498	64,532	12	20	32	54	Democrat
WA09	2,851	64,532	66	116	176	308	Democrat
WA10	360	64,532	8	15	21	39	Democrat
TOTAL	**10,765**	**64,532**	**249**	**437**	**664**	**1164**	

Greater Seattle Metro Area: Non-white

Public housing   Congressional districts   Roads   Water

Percent nonwhite

0%   100%

3 ft SLR   7 ft SLR   10 ft SLR

Greater Seattle Metro Area: Unemployed

Public housing   Congressional districts   Roads   Water

Percent unemployed

0%   35%

3 ft SLR   7 ft SLR   10 ft SLR

PART 4:
Indian Housing Needs a Green New Deal

There are 2,632,102 American Indians and Alaskan Natives (AIAN) living in the United States today.[35] About 60% live in tribal areas or adjacent counties (HUD 2014, xiii). Based on most recent estimates,[36] there are approximately 78,237 AIAN HUD supported' units—units built under the Housing Act of 1937 and Indigenous Housing Block Grant (IHBG)—standing today.[37] A 2017 HUD study found that tribal areas require 68,000 new housing units—33,000 to eliminate overcrowding and 35,000 to replace deteriorated stock.[38] This shortage can be filled by increasing IHBG funding to match population and infrastructure demands, but should be paired with extensive retrofits.

Housing in tribal areas is in dire need of extensive repairs, made even more urgent by the fast growing AIAN population.[39] This report proposes combining green retrofits with other necessary capital repairs to improve current tribal housing conditions, meeting rising resource demand, increase affordability, and improve health outcomes while reducing carbon emissions.

We did not consider the data that we found sufficiently robust to estimate costs and numbers of units that would be affected by a green retrofit program. An immediate priority for a Green New Deal for Public Housing is to fund a careful assessment of all tribal housing under federal purview, with a view to scoping out a ten-year plan for green retrofits.[40] Given the large range of our overall estimate of costs, and an assumption that costs will fall as skills and technologies improve over time, we expect a fully funded retrofit program for Indian Housing could be funded in the broad budget range sketched in this report.

The Current Neglect of Indian Housing

While tribal housing conditions vary by community, there is a universal agreement that there is a massive shortage of AIAN housing and that the existing tribal housing stock faces extensive problems in physical condition, system deficiencies, affordability, health, and safety. In a 2017 report titled *Broken Promises: Continuing Federal Funding Shortfall for Native Americans*, the United States Commission for Civil Rights emphasized that the conditions of Native American housing are "substandard" and resolution is "critically and immediately important." Yet poor conditions have been perpetuated by a federal withholding of adequate Indian Housing Block Grant (IHBG) funding. As a result of disinvestment, *ten times more Native households have a lack of plumbing facilities* (USCCR 2017, 136-8) and *six*

times more have a lack of adequate heating (HUD 2017, xviii) than the United States average.

This inequity in housing conditions between AIAN populations and the rest of the nation makes the impetus for change that much more urgent. And people have been noticing - Democratic Nominees Julián Castro, Bernie Sanders, and Elizabeth Warren all have made tribal housing a policy issue of focus. Warren in particular notes "too many (tribal) homes are contaminated by lead, asbestos, or dangerous chemicals, with severe health implications for the community."

In addition to problems in physical conditions and health, tribal areas have huge affordability issues. AIAN households have *1.8 times the poverty rate* of the rest of the Nation (HUD 2017, xvii), and *40% of homes are rent burdened[41]* (HUD 2014, xv). High energy costs compound the affordability crisis. Tribal households have a greater need to use temperature systems to combat extreme weather conditions (HUD 2013, iv). But high energy-use levels are only part of the problem; energy costs are another. In Alaska, for example, many tribes are dependent on diesel, an expensive fuel to ship that often fluctuates in price (DOE 2017, 4). Poverty and rent burden make it challenging to pay for these elevated energy bills. Furthermore, in the Southwest, 14.2% of households are not even connected to an electricity grid (DOE 2017, 3).

The Case for Green Retrofitting

As evident, AIAN housing is in urgent need of extensive repairs and needs greater IHBG investment. Capital repairs paired with green retrofits, rehabilitation, workforce training and programs to empower tribes to self-determine will improve affordability, health outcomes, and living conditions in assisted tribal housing. Furthermore, thousands of jobs will be created in tribal areas, promoting local economic development and strengthening tribal sovereignty.

This section will outline some methods of green retrofitting in alignment with already-necessary repair work. The techniques are intentionally broad, as they must be adapted to the varying conditions, cultures, and climates of tribal housing across the United States.

Physical Improvements and Energy Efficiency

23% of tribal area homes have a physical condition problem (HUD 2017, xviii). Physical conditions repairs include fixing leaking roofs and removing molding walls. When paired with green retrofits, roof maintenance can include the installation of water catchment devices and solar PV panels to increase energy and potable water supply in areas lacking infrastructure.

For abetting system deficiencies, retrofitting can improve access to basic amenities such as heating, lighting, and sewage, while limiting resource usage. Where plumbing systems need to be installed or replaced, more efficiency can be gained through the retrofitting of grey-water recycling into bathrooms, redirecting sink water to fill toilet bowls. Further, energy consumption can be reduced 6.6 times by replacing all lightbulbs with LEDs (NREL 2019, 13).

In terms of temperature regulation systems, retrofitting can include altering building envelopes through installing roof, floor, and wall insulations as well as low-E triple-paned windows. Cooling mechanisms can be built through installing Energy Recovery Ventilators (ERVs), ceiling fans, and external shades for windows in summer. Furthermore, high-efficiency HVAC systems should be built utilizing ground-source heat pumps powered by solar (Semprini et al. 2017, 335) (Jafari 2017, 79).

Green retrofits like water catchments and solar panels do not require significant infrastructure buildout, providing safe and essential services to AIAN households, meeting the demands of a growing population while reducing waste and promoting safe and healthy living conditions. **These retrofits can increase comfort and positive health outcomes for Native families while building tribal resiliency through a green transition.**

Renewable Energy

In the process of improving energy infrastructure, clean energy systems — such as solar and community wind — should be built to eliminate dependence on electricity from fossil fuel. Renewables can decrease the cost of energy, and conversion from diesel engines to wind energy (supplemented by solar and batteries) would remove the risk of fossil fuel price fluctuations in places like Alaska.

Further, there are positive health outcomes associated with reducing dependence on fuel oils. Continual exposure to diesel exhaust has been linked to higher rates of lung cancer, inflammation, and aggravated asthma. Children are particularly prone to increased illness and decreased lung function. Burning diesel also creates nitrogen oxides that contribute to smog and damage lung tissue (OEHHA 2001). Reducing reliance on fuel oil will improve the health and living conditions of many tribal nations.

Another benefit to community renewables is that they are delocalized from the national grid; empowering tribes to own and operate their own tribal grids—fostering self-government and strengthening sovereignty.

Photo by Arnaud Chanteloup on Unsplash

PART 5:
Tailor retrofits based on individual building conditions

Retrofits are needed for two purposes: the health, comfort, and dignity of residents and decarbonization.

There are two major ways of eliminating carbon emissions for buildings: (1) efficiency gains, achieved by reducing energy demand; and (2) decarbonization, by changing the energy source.

More precisely, for a building to minimize its energy use, the impact of its exterior environment should be minimized; energy consumption of equipment should be minimized; ambient conditions and thermal mass should be leveraged (free cooling, passive solar heating, thermal storage, daylighting, etc.); HVAC system efficiency should be maximized; high efficiency lighting systems and plug-in devices should be utilized; and systems should be controlled separately (cooling and ventilation for example).[42] Solar panels, on building roofs or in nearby arrays, can further lower energy costs and provide back-up power, especially when supplemented by batteries. Energy storage will be necessary to alleviate grid stress during peak hours.

The specifics of any particular green reotrift's implementation of these principles will depend on context, down to each individual building, and improving technologies and techniques.

When it comes to public housing, there are three major types: single family residential, small multifamily residential (triple deckers of 2-4 units), and large multifamily residential (5 or more units).[43] Finer distinctions complicate these gross divisions, as retrofitting a single duplex unit differs in impact from retrofitting an entire complex or a tower.

In general, updating a single unit within a multifamily building will have a lesser impact; retrofits should be done with a systematic "whole building" approach. And all green retrofits should be done at the same time as all needed capital repairs to minimize costs and expedite the process.

To best support this goal, additional housing should be built for residents who may be temporarily displaced by retrofits. (To be sure, these relocations can be very brief, lasting from one to five days; in some cases, however, retrofits will take longer.) This can come in the form of temporary housing, or our preferred option of new structures that can serve as public housing when retrofitting of existing structures is complete. In every case, the presiding PHA should administer the program so that there is zero real or perceived risk of permanent displacement.

Retrofits for All Housing Types

This report relies on the [Carbon Free Boston Buildings Technical Report](#) as a recent and comprehensive investigation into public housing typologies and retrofits. Points of divergence or elaboration are indicated with secondary sources.

Overall the most crucial factor in cutting building emissions is decarbonization. This requires a transition from fossil fuels. It is important to note that the full decarbonization strategy, requires building electrification, which will depend on larger grid improvements. Other considerations include:[44]

▶ Energy Efficiency

▶ Peak Demand + Load Shifting

▶ Water Efficiency

▶ Materials efficiency

▶ Indoor Environmental Quality (mentioned below)

Apart from these energy-oriented strategies, it is also important to consider the indoor environmental quality (IEQ) of units to meet the needs of occupants. IEQ considerations include:[45]

▶ Indoor Air Quality

▶ Lighting Quality

▶ Quality of Views

▶ Acoustical Performance

▶ Thermal Comfort

The above retrofits center on improving existing conditions. But these conditions are changing with the climate. Further study is needed to determine the best way to deal with these changes, but preliminary recommendations follow. With an increase in extreme weather conditions and sea level rise will come an increase in flooding. For all units located within the 3ft flood zone or 100 year floodplain, we recommend immediate replacement of any units lost because of

climate threat (or damage beyond repair) at a 2:1 ratio, and the waterproofing of ground floors for intact units where feasible. In the case of extreme temperatures, more energy input will be required to regulate interior temperatures (especially in the case of elderly housing). Housing in extreme temperature zones will need robust heat pumps and cladding/insulation as well as excellent ventilation, and energy recovery systems, to ensure high indoor air quality along with greatly increased insulation.

Retrofits Differ by Building Typology

As well as its size and region, a structure's age and typology determine the appropriate retrofits. The majority of US public housing was built after 1930 with an influx of subsidised buildings in the early 1940s that were later transitioned to public housing. This build period impacts the needed retrofits, as housing stock built in the 1930s differs significantly in terms of materials and standards/codes to stock built in the WWII period and the 1990s. These buildings will have different needs for insulation, window panes, and appliance replacement (stoves, hood ranges, and toilets). Investigation into the age of the public housing stock and its most recent capital improvement projects (if any) is necessary to determine appropriate retrofits. This must all be coupled with the electrification of the housing stock and a transition away from natural gas.

The consideration of the grid itself is important in the context of the electrification of public housing. Electrification of building systems is necessary for full decarbonization: without a carbon-neutral grid these buildings cannot achieve zero emissions. The Green New Deal for Public Housing Act therefore presumes at least the availability of zero-carbon energy. Additionally, PHAs will be able to generate their own zero-carbon energy through solar panels and other means. The profits (up to 90%) from the sale of any new energy generated on site will go to the PHAs to disperse.

The optimal strategy will depend on the structure type and its corresponding energy use intensity (EUI). For single family structures, a heat pump in combination with a tightened building envelope (overcladding and

insulation) has a significant impact on energy use, in particular when paired with rooftop solar and a battery. In colder climates, HVAC electrification has the greatest impact on carbon emissions, as heating demand is significant for smaller multifamily residential buildings. For larger multifamily residential buildings, the retrofits with the greatest impact on energy use are HVAC improvements and the electrification of end uses—without electrification, the efficiency of appliances has only a moderate impact.[46] Large multifamily buildings may be comparable to commercial buildings in terms of energy consumption and therefore those resources may be consulted for best practices (i.e. ENERGY STAR Guidelines for Energy Management).

An important consideration for multifamily buildings is the installation of sub-metering as opposed to net-metering during the retrofitting process. Typically this presents an issue of 'split-incentives.' Owners are not incentivized to improve the efficiency of units in submetered buildings, as tenants reap the benefits. In net-metered buildings the tenants are unaware of their energy consumption and therefore not incentivized to reduce energy use. However, introducing a submetering system can allow property managers and tenants to better monitor unit-level energy consumption.[47]

Retrofits Differ by Climate Zone

The energy consumption of a building, and subsequently the appropriate retrofits, vary by climate region. A project's EUI is determined by the site energy and source energy of the structure; both of these factors are defined by the climate zone and guide retrofits in pursuit of zero energy.[48]

Building America, The Department of Energy's housing efficiency research program, recognizes climate regions that were developed by Department of Energy (DOE) researchers at Pacific Northwest National Laboratory to inform retrofits.[49] These regions, represented in the International Energy Conservation Code map, divide the US into zones based upon temperature, and further divides them based on moisture for a total of 24 designations: Marine, Cold/Very Cold, Mixed-Humid,

Hot-Humid, Hot-Dry/Mixed-Dry and Sub-Arctic (Alaska). These climate zones are incorporated into local and state building codes, guided by ASHRAE and DOE documents.

IECC climate zones are used to identify the optimal retrofit strategy, informing the appropriate energy conservation measures (ECMs) for a given region. For example, regions with cold winters are at risk of freezing and bursting plumbing as well as condensation within wall roof assemblies. Condensation can also occur in hot weather, particularly in buildings with large air conditioning systems or areas with high humidity. Airtight HVAC systems and proper ventilation, as well as sealed building enclosures, can help control moisture.[50] The Pacific Northwest, in the Marine zone, often sees electric furnaces replaced with high-efficiency heat pumps. In the Southeast mixed-humid climate, homes within the city of Atlanta commonly called for HVAC upgrades.[51] In climate zone 2A (Tampa, FL) cooling and dehumidification are required, while reduction of heat loss and heating efficiency are appropriate for 6A (Rochester, MN).[52]

Building envelopes (wall, fenestration, roof) and HVAC system capabilities all typically differ dependent upon region.[53]

The best ECMs for a building are subject to change however, due to changes in future climate conditions.[54] While methods are currently being explored to evaluate the complexity of decision-making around retrofit ECMs and climate change, there is still much work to be done to systematize these considerations.[55] Thus, the resiliency planning, like the resiliency centers in public housing complexes proposed by the Green New Deal for Public Housing Act, should be tailored to local climatic context. In areas where weather events may become more common due to climate change, the possibility of extended utility outages should be factored into retrofit design, to ensure that public housing units have enough solar energy and backup power to outlast outages and support their broader communities.[56]

Conclusion

The Green New Deal for Public Housing Act presents a generational opportunity to restore and revitalize US public housing, bringing over a million units of extremely affordable housing to the highest possible standards, and in so doing enabling a decent life for residents, creating hundreds of thousands of jobs per year (including tens of thousands for public housing residents), and slashing carbon emissions. Our research finds ample reason to be optimistic. We can solve multiple massive problems at once through efficient, cost-effective investments that improve everyday life and eliminate carbon emissions in a short decade of hard work.

APPENDICES

Jobs and Costs by Region Methodology

Recent, comprehensive data on public-housing capital needs nationally is currently sparse. The last publicly available study was commissioned by HUD in 2010. While HUD is collecting more recent data on capital needs and retrofit costs, they declined to provide us with it, instead suggesting that we file a Freedom of Information Law (FOIL) request, which we were unable to do in time for this report.[57]

We therefore base our cost estimates on the 2010 capital needs report, which is also cited in other recent discussions of national capital need.[58] This HUD report provided estimates for current (in 2010) capital needs faced by public housing authorities nationally, as well as estimated cost accruals through the following twenty years. However, these cost accrual estimates were based on the assumption that "all existing needs are met" each year. Due to the immense and increasing capital backlog that has persisted for so long in so many PH developments, the rate of deterioration has often sped up, making the new accruals estimated in that report likely excessively conservative.

Given this reality, we gauged the current reasonableness of estimates based on the 2010 report against capital needs estimates for NYCHA, a PHA for which there was more recent, comprehensive data. For NYCHA, the 2010 HUD report estimates the Authority would need about $10 billion in repairs by 2020, but a 2017 study showed a much higher need of nearly $32 billion. Due to the size of the gap, the extent to which funding has been withheld from NYCHA at all levels of government (including state and city), and qualitative research that suggested that more structural components in NYCHA developments are reaching the end of their projected useful lives (due to more consistent maintenance of public housing, and a greater reluctance to demolish or abandon aging developments),[59] we determined it was likely not necessary to scale estimates from the HUD report by a factor that would make its NYC estimates match those in more recent studies. The comparison did, however, convince us that it was likely necessary to provide a cost range that included the possibility that estimates from the 2010 HUD report were significantly below actual, current costs. The high end of this cost range could also include added cost differences from deeper retrofits.

With this understanding, we obtained per-unit repair costs by adding twenty years of accruals estimated in the HUD report to the current (in 2010) need in that report. Twenty years of new needs from 2010 takes us to the end of our capital spending program. Our cost estimates therefore include replacements, not only building

systems *currently* in need of repair, but also those in imminent need. These estimates, based on 2030 capital need projected based on the HUD report, comprise the *low* end of the per-unit costs we estimated. This is the per-unit cost estimate reported in most tables throughout this report. For the high end of the range, we scaled these estimates up by 75%.

Additionally, costs are not identical for PHAs throughout the country. We therefore matched public-housing developments to census region, and allocated different estimated per-unit costs based on region. The HUD report supplied the projected regional cost variation.

Using spatial data from HUD and the Census Bureau, we then matched PH developments to states, districts, and metro areas. We paired developments with state-level average wages in the construction sector from the Quarterly Census of Employment and Wages (QCEW), retrieved from the Bureau of Labor Statistics.

Average construction wages and estimated per-unit costs allowed us to estimate on-site jobs at each of our reporting levels (state, congressional district, and metro area.) We used an estimated percentage of construction labor as share of total costs to estimate total wages for on-site work at the level of aggregation, and then divided by the average construction wage in that aggregation-area to get estimated jobs. To get from total on-site jobs to total Section 3 jobs, we multiplied the total by the average hiring requirement over the ten-year period of the plan (75%). For new jobs for PH residents, we multiplied the total by an adjusted-downward percent (37.5%).

National Impact Methodology

To estimate national impact, we took the percentage breakdown of spending by sector worked out for NYCHA,[60] based on more recent and abundant data, and scaled these percents by our total national spending estimates. This gave us an industry breakdown of direct demand shocks associated with the plan. We then applied this dollar breakdown to a set of national employment multipliers from the Employment Policy Institute to get national job generation.[61] Our national numbers include indirect and induced jobs generated through this spending, unlike our regional estimates for on-site jobs and jobs for public housing residents, which only include direct jobs.

Carbon Emission Methodology

Recent comprehensive public data for national PH energy and fuel consumption is similarly spotty. In our companion report on NYCHA, we were able to provide more precise numbers based on information on NYCHA's utility usage in the City's OpenData portal and NYC-specific ratios to convert from energy usage to emissions from the City's Comprehensive Environmental Quality Review manual (CEQR). For this report, we pieced together multiple sources and estimated current emissions based on sets of national averages. For this reason, our national emissions estimates are less precise than our NYCHA estimates, but still provide very reasonable approximations.

To estimate carbon emissions, we took the last reported breakdown of national public housing utility expenditures[62] and scaled up to total dollar expenditures reported by the EPA[63] to get a dollar breakdown by utility. From there, we used national price per-unit averages from the Energy Information Agency (EIA) to move from spending approximations to consumption. Then consumption-emission ratios were obtained from the EPA for each utility category to convert from consumption to emissions.

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17. Public housing reotrifts around the world have delivered energy savings of up to 60%, we assume that by adding solar energy, undertaking more extensive retrofits, and allowing for cases around the world where higher energy savings are impossible, we conservatively estimate 60%-70% potential energy savings. (We achieve zero carbon by eliminating all natural gas, and we reduce total energy use and cost through efficiencies including more efficient windows, appliances, insulation, and heat pumps.) Eg, more modest energy retrofits of a major public housing project in Paris, with early 2010s technology, achieved energy savings of 60%
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19. Public housing reotrifts around the world have delivered energy savings of up to 60%, we assume that by adding solar energy, undertaking more extensive retrofits, and allowing for cases around the world where higher energy savings are impossible, we conservatively estimate 60%-70% potential energy savings. (We achieve zero carbon by eliminating all natural gas, and we reduce total energy use and cost through efficiencies including more efficient windows, appliances, insulation, and heat pumps.) Eg, more modest energy retrofits of a major public housing project in Paris, with early 2010s technology, achieved energy savings of 60%. See Kimmelman, Michael. 2012. "At Edge of Paris, a Housing Project Becomes a Beacon." New York Times. March 27. https://www.nytimes.com/2012/03/28/arts/design/renovated-tour-bois-le-pretre-brightens-paris-skyline.html

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24. Cinnamon Janzer. 2019. "More Than 100,000 Public Housing Units Have Been Privatized Under This Program. What's Next?" Next City. November 12. https://nextcity.org/daily/entry/more-than-100000-public-housing-units-privatized-under-program-what-next

25. For a discussion on how these and other estimates were made, see the Appendix in this report.

26. Based on national employment multipliers from the Economic Policy Institute and estimated spending of $143 million for new refrigerators, stoves, and toilets for NYCHA units" with "spending of $670 million for new refrigerators, stoves, and toilets for the country's public housing units.

Bivens, Josh. 2019. "Updated employment multipliers for the U.S. economy." Economic Policy Institute. https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/

27. Cost differences reflect both climactic factors, preponderance of of housing types—eg, larger complexes tend to be more expensive to retrofit, building lifecycle variations, and initial needs at the time of the HUD report.

28. https://www.huduser.gov/portal/datasets/assthsg.html Dataset query of 'public housing' for 2018 (based on 2010 census geographies)

29. Puerto Rico has a single "at large" congressional district.

30. P.U. Clark et al. 2016. "Consequences of twenty-first-century policy for multi-millennial climate and sea-level change", Nature Climate Change, vol. 6, pp. 360-369, 2016. http://dx.doi.org/10.1038/nclimate2923

31. National Oceanic and Atmospheric Administration. N.d. Sea Level Rise Viewer. https://coast.noaa.gov/slr/

32. Federal Emergency Management Agency. N.d. National Flood Hazard Layer (NFHL). https://www.fema.gov/national-flood-hazard-layer-nfhl

33. See https://www.huduser.gov/portal/datasets/assthsg.html#2009-2018_query. We only queried Public Housing and pulled most recent available data from 2018.

34. Note, These estimates, as well as administrative boundaries and other relevant shapefiles maintained by Census (roads, water bodies, parks, Congressional Districts), were pulled using the tidycensus and tigris R packages developed and maintained by the Census Bureau.

35. AIAN alone. ACS 2017 5-Year Estimates

36. After the passing of the Native American Assistance and Self-Determination Act (NAHASDA) of 1996 tribes were given primary responsibility to utilize federal and other assistance in housing construction/rehabilitation through the Indian Housing Block Grant (IHBG) beginning in 1998. HUD's Office of Native American Programs (ONAP) is responsible for overseeing funding and distribution based off of the IHBG formula. Pre-NAHASDA AIAN public housing (housing funded through the 1937 Housing Act) is referred to as Formula Current Assisted Stock, and receive a sum of IHBG designated funds for maintenance prior to the IHBG formula distribution.

37. In a report from ONAP to Congress on FY 2018 (October 2017-September 2018) HUD estimated that 40,268 units have been built or acquired since the beginning of the IHBG program. According to FY 2018, there were an estimated 37,969 FCAS units remaining. These figures imply that there are approximately 78,237 AIAN 'public housing' units today. It should be noted however, that HUD estimates of IHBG units do not distinguish between newly constructed units and those that have been constructed to replace existing housing stock. Additionally, these and existing FCAS unit numbers are self-reported by Tribal Housing Authorities (IHAs). The estimated housing stock does not necessarily correlate with tribal areas, as some IHAs receive IHBG funds but are not located on reserves. ONAP October 2017-September 2018 data was sourced through personal correspondence

38. U.S. Department of Housing and Urban Development "Housing Needs of American Indians and Alaska Natives in Tribal Areas" Jan 2017, https://www.huduser.gov/portal/sites/default/files/pdf/HousingNeedsAmerIndians-ExecSumm.pdf

39. IANA's population growth is 12% compared to the national rate of 10% (HUD 2017, xvi)),

40. HUD has recently deployed the Green Physical Needs Assessment (GPNA) tool to track these needs and estimated costs nationwide. However, the data for this tool is not public, and we were asked to file a Freedom of Information Law (FOIL) request to obtain it, which we

were not able to do in time for the release of this report. Therefore there may be data on this, but if so, it is not currently public. HUD's GPNA tool is hosted here: https://www.hud.gov/program_offices/public_indian_housing/programs/ph/capfund/gpnatool

41. Data from 2006-10
42. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. The American Institute of Architects, Illuminating Engineering Society, U.S. Green Building Council, U.S. Department of Energy. 2019.
     "60% Preliminary Technical Review Draft." https://www.ashrae.org/File%20Library/Technical%20Resources/AEDGs—SpecialProjects/AEDG-MF-ZEB-60—ReviewDRAFT-18Oct2019-Locked.pdf
43. Hatchadorian, Rebecca, Rob Best, Katie Wholey, Alexandra Calven, Erica Levine, Sara Tepfer, Brian Swett, Michael J. Walsh, Adam Pollack, Taylor Perez, Joshua R. Castigliego, and Cutler J. Cleveland. 2019. "Carbon Free Boston: Buildings Technical Report." Boston University Institute for Sustainable Energy, Boston, MA, USA. http://sites.bu.edu/cfb/files/2019/06/CFB_Buildings_Technical_Report_061719.pdf . p. 3.
44. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. The American Institute of Architects, Illuminating Engineering Society, U.S. Green Building Council, U.S. Department of Energy. 2019.
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45. ibid.
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51. Pacific Northwest National Laboratory. 2015. "Building America Best Practices Series, Volume 7.3: Guide to Determining Climate Regions by County" https://www.energy.gov/sites/prod/files/2015/10/f27/ba_climate_region_guide_7.3.pdf
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57. https://www.hud.gov/sites/documents/PH_CAPITAL_NEEDS.PDF. As mentioned in another endnote in this report, HUD has also recently deployed the Green Physical Needs Assessment (GPNA) tool to track capital needs needs and estimated costs nationwide. However, the data for this tool is not public, and we were asked to file a Freedom of Information Law (FOIL) request to obtain it, which we were not able to do in time for the release of this report. For lack of this information, we therefore used the best available public data.
58. https://www.hud.gov/sites/dfiles/CFO/documents/6%20-%20FY19CJ%20-%20Cross-Cutting%20-%20Rental%20Assistance%20Demonstration.pdf
59. See Nicholas Dagen Bloom, Fritz Umbach, and Lawrence J. Vale. 2015. Public Housing Myths (Cornell University Press). In particular: "If anything, NYCHA's biggest challenge today is that it has maintained its developments so much better than other cities that the system now demands massive capital, now in short supply, for renovating building systems that have reached the end of their projected lifespan" page 95.
60. See the appendix to our companion report on NYCHA for more details
61. https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/
62. https://www.huduser.gov/publications/pdf/energybook.pdf
63. https://www.epa.gov/sites/production/files/2015-08/documents/affordable_housing.pdf

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