Heat Island Assessment & Mitigation Plan

5 Points **10 Points** **15 Points** **20 Points**

Updated February 2023

This action was modified in February 2023 to help municipalities fulfill components of the 2021 amendment S-2607 to New Jersey's Municipal Land Use Law (MLUL) that requires a climate change-related hazard vulnerability assessment when updating the Land Use Element of a Master Plan. Completing this action provides a municipality with information on their vulnerability to extreme heat.

A tiered and variable point system has been added to this action to encourage all types of municipalities - urban, suburban, and rural - to undertake the analysis outlined in this action in order to determine if heat islands are prominent in their community. Additional modifications include the use of more current data in the Heat Island Map, new climate change-focused resources, and updated technical guidance.

Sustainable Jersey, with support from the New Jersey Department of Environmental Protection (NJDEP) updated a number of actions - including this one - to advance climate resilience planning, adaptation, and emergency preparedness at the municipal level. Please refer to Sustainable Jersey's Interim Resilience Planning Guidance for more detail.

The goal of this action is to help municipalities identify and address a specific sustainability issue at the intersection between public health and climate change. A Heat Island Assessment supports strategic climate resilience planning, and the development of a mitigation plan can work in partnership with Green Infrastructure Planning, Green Infrastructure Implementation, Community Forestry Management Plan, and Complete and Green Streets for All Policy activities to create communities that thrive in the face of climate change impacts. Additionally, community engagement serves as a foundational component of this action. Municipalities that complete this action will engage with community members, particularly socially vulnerable individuals, to identify and assess the effects of localized heat islands and create meaningful mitigation strategies.

A municipality can earn up to 20 points overall for this action. The points will expire after 5 years. Those that determine heat islands are not an issue will not have to prioritize completing this action beyond Tier 1.

Tier Level	Requirements	Points earned
Tier 1	Heat Island Assessment - Use Sustainable Jersey's New Jersey Heat Map (or other data) to conduct a heat island assessment and, if present, evaluate hotspots' effects on residents and workers in the area. Share findings with the local planning board.	5 points
Tier 2	Heat Island Mitigation Plan - If hot spots are identified in the Heat Island Assessment, municipalities must develop recommendations in the form of a Heat Island Mitigation Plan to mitigate the heat island effect in relation to specific hotspots. Communities must demonstrate the involvement of relevant stakeholders in the development of heat island mitigation strategies, especially if they are related to vulnerable populations.	Additional 5 points (10 points in total when completed alongside Tier 1)

Tier 3	Plan Implementation - Municipalities must implement at least one recommendation in their Heat Island Mitigation Plan. A municipality can earn another 5 points if strategy implemented in Tier 3 directly reduces the impact of hotspots for vulnerable populations.	Additional 5-10 points (15-20 points in total when completed alongside Tier 1 and Tier 2)

For certified communities, this action can count toward a Gold Star in Health. See the Gold Star Standard section of this action for more information. Additionally, prior or concurrent completion of the Community Equity and Diversity Profile action will be helpful toward fulfilling the requirements of this action and is highly recommended.

Why is it important?

Individual lots, roads, and other paved areas often experience warmer temperatures compared to the rest of the state due to the urban heat island effect. Despite its name, this phenomenon can occur anywhere impervious surfaces absorb and reradiate solar energy - including suburban and rural areas. This action will use the general term “heat island” or “the heat island effect” henceforth. The heat island effect is primarily caused by a lack of vegetation and the absorption of solar radiation by large amounts of dark surfaces (principally buildings and asphalt) and can lead to significantly higher temperatures in areas called urban heat islands or "hotspots." The higher temperatures in these areas can cause or exacerbate heat-related illnesses such as heat cramps, heat exhaustion, heat stroke and even death. In addition, these increased temperatures contribute to a general poor quality of life for those who live, work, and play in those areas. Finally, efforts to offset these increased temperatures through air conditioning increases energy demand and strain on the electrical grid, and can elevate air emissions depending on the source of the electrical energy (i.e., natural gas vs. renewables). Fossil fueled energy use creates localized air pollution known to increase asthma rates and other respiratory diseases, as well as contributing to climate change.

While the existence and impacts of heat islands have been recognized for many decades, the current and predicted increase in regional and global temperatures is adding concern for the health and safety of residents living in these environments. According to the New Jersey Department of Environmental Protection’s 2020 Scientific Report on Climate Change, New Jersey’s average annual temperature has increased by 3.5°F since 1895[1]. This increased baseline temperature sets the backdrop for persistent changes that will continue to permeate every facet of day-to-day life.

The State’s 10 warmest calendar years on record all occurred after 1990, while the 10 coldest calendar years on record all occurred before 1940[2]. The State’s warmest year was 2012 when the average annual temperature was 4.1°F above the long-term average and 3.0°F above the 30-year normal[3]. This warming trend is expected to continue in New Jersey:

> *Global climate models that factor in future greenhouse gas emissions are used to project the magnitude of future temperature increases. Projections published by Runkle et al. (2017) are based on two scenarios, one in which greenhouse gas emissions continue to increase at the current rate (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Under both scenarios, historically unprecedented warming is projected in the 21st century. Even under a low emissions scenario, the lower end of the projection range suggests that annual temperatures will routinely be as warm as the warmest years in the historical record. Under a high emissions scenario, future annual temperatures could be as much as 10°F (5.6°C) warmer than the historical record*[4].

Municipalities should expect that local temperatures in areas already suffering from heat island effect could be several degrees above that predicted average, resulting in significant public health challenges, cooling costs, energy demands, and potential lower air quality.

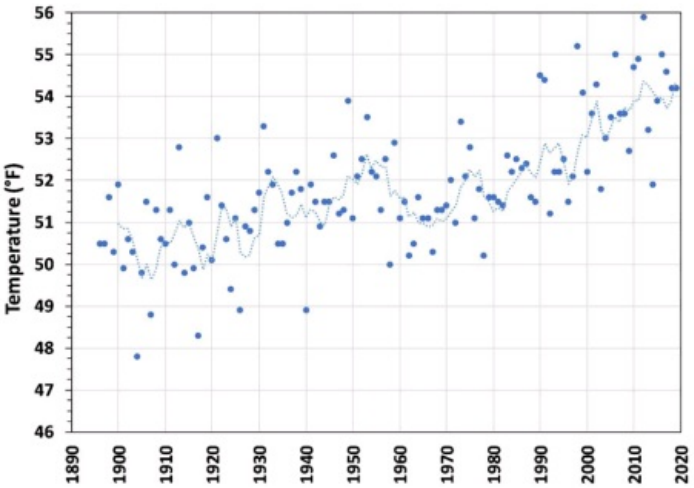

Figure 1: New Jersey 12-Month Average Air Temperature from 1895 to 2019. Points represent the average annual temperature and the dashed line represents a five-year average of those points. (Source: NJDEP 2020 Scientific Report on Climate Change, pg 32)

Health Impacts

As ambient temperatures increase due to climate change extreme heat will become more of a public health threat, with heat waves occurring more frequently and lasting longer. Extreme heat exposure is a serious direct threat to human health that can also exacerbate underlying illnesses such as cardiovascular disease, diabetes, psychological distress, and asthma[5]. Extreme heat may also cause or exacerbate both acute and chronic kidney disease, with outdoor workers being particularly susceptible to kidney injury or failure due to consistent exposure to hot temperatures[6]. Beyond being the leading weather-related cause of death in the US, extreme heat events also have a higher mortality rate compared to all other weather events combined[7]. Although reported deaths from extreme heat exposure annually in the US is over 1,000 people (and growing), universal billing codes used to characterize the reason for hospitalization can mask primary triggers, meaning that number is likely orders of magnitude higher[8]. Populations vulnerable to extreme heat include the homeless; children and the elderly; and outdoor workers. The Heat Island Effect magnifies exposures to heat in these areas, which often coincide with socially and environmentally overburdened communities. These effects will ultimately result in a greater number of vulnerable and health-compromised residents and visitors visiting the emergency room seeking treatment. Temperature extremes also adversely impact birth outcomes, including changes in length of gestation, birth weight, and neonatal stress[9]. These birth outcomes create a greater risk of infants dying in their first month of life, requiring intensive care at birth, and developing disabilities and chronic illnesses throughout their lives. Newborns are highly susceptible to heat-related morbidity and mortality[10].

The Costs of Cooling

The costs of cooling buildings (homes, schools, libraries, civic centers, hospitals, sporting arenas, community spaces, etc.) is steadily increasing, resulting in strained budgets for households, municipalities, businesses, community service providers and other property owners. According to the United States Energy Information Administration, “the average retail price of electricity in New Jersey is among the top 10 states[11]." It is estimated that New Jersey residents pay approximately 14 cents for each kilowatt-hour their air conditioners are running - a rate that can add up quickly depending on the air conditioner’s size, cooling capacity and efficiency[12]. This becomes particularly burdensome for financially vulnerable households and businesses that do not have the financial means to bear the increased expenditures.

Increased Energy Consumption’s Effects on Air Quality

Increasing temperatures put additional energy demand on the State’s electricity grid to adequately cool public and private buildings. This problem is even more severe in heat islands where temperatures are slow to decline during the evening and generally remain warmer than their non-heat island counterparts through the overnight hours. One study suggests that 5-10% of community-wide demand for electricity is used to compensate for the heat island effect[13]. For those utilities that rely upon fossil fuel, the increase in energy consumption leads to increases in air pollutants and greenhouse gas emissions.

Who should lead and be involved with this action?

The municipal Green Team can use the New Jersey Heat Island Map to prepare an initial assessment and work with other relevant municipal staff and community stakeholders to understand the impact of heat islands on those most vulnerable to heat stress and/or create heat island mitigation strategies.

The development of a mitigation plan will likely include a range of expertise found in the community. Strategies focused on urban forestry will benefit from the involvement of representatives from the shade tree commission. Similarly, planning board members and the municipal staff that serve them are best suited to identifying heat reduction opportunities in planning and zoning standards. In the case of cool surfaces, code enforcement officials and those overseeing public works projects will have expertise in local road conditions and uses. Finally, the town/city council should be involved to pass relevant ordinances. The Public Works Department and private owners should also be engaged if discussing or implementing mitigation strategies. Mitigation will often require the removal or modification of the existing build environment and will likely require additional expertise. Depending on the community, the stakeholders involved in heat island mitigation planning should include:

- Relevant community stakeholders, especially those most vulnerable to heat stress and heat islands
- Shade tree commission (or committee) members, natural resources or open space management professionals
- Local or regional public health officials
- Planning board and staff
- Municipal public works staff
- Local or county emergency management staff
- Engineering staff
- Municipal public information officials
- Housing authorities
- Interested and impacted community groups
- Governing body of the municipality
- Representatives of energy utilities and power distribution companies
- Landscape industry representatives
- Environmental justice organizations active in the area

Timeframe

Green Teams should be able to complete tier one of this action in one to three months. Additional time will be needed to develop a Mitigation Plan to ensure various stakeholders participate in the heat island mitigation planning process. The tools needed for the assessment exercise are online and easily accessible at any time (see “How to” section for technical guidance worksheet).

Project costs and resource needs

Overall costs will be minimal for completing Tier One as a volunteer can use the Heat Island Map to assess the community’s vulnerability. Development of a Heat Island Mitigation Plan will depend on the approaches used for strategy development. While volunteers can be used to facilitate the development of the Heat Island Assessment, the Mitigation Plan will likely need expertise of municipal staff and professionals, as well as the members of relevant municipal boards and commissions (environmental commission, shade tree commission members, public health officials, public works staff, emergency management officials, municipal communications and outreach specialists, and/or representatives of community groups, etc.). Determining the Heat Island mitigation strategies related to vulnerable populations must be created in consultation with said population or a municipal staff person who is knowledgeable of or works closely with vulnerable populations. Green teams should consider how much of the plan development for this action could be completed using in-kind and volunteer support whenever possible.

What to do, and how to do it ("How to")

This section provides guidance and recommendations for implementing the action plan using Sustainable Jersey’s New Jersey Heat Island Map. A municipality does not need to follow this guidance exactly so long as their methodology meets the requirements for earning points for this action.

A municipality that has access to more detailed data based on local heat monitoring is encouraged to use that information when completing its Heat Island Assessment. A municipality can earn up to 20 points for this action based on the three tiers outlined below.

For a tutorial on how to prepare an assessment and mitigation plan, please refer to this action's Technical Guidance.

TIER 1 (REQUIRED): Develop a Heat Island Assessment in collaboration with vulnerable residents and workers. (5 points)

While there are various ways to measure and analyze heat island effects, this action uses land surface temperature (LST) maps generated by Landsat 8 satellite imagery. The term "land surface" refers to horizontal surfaces, including land, buildings, parking lots, etc. To analyze the size and strength of the heat islands in your community follow the steps listed below.

1) Go to Sustainable Jersey's New Jersey Heat Island Map. Zoom to or search for your municipality.

2) Determine whether your community experiences heat island effects. Communities with only yellow and orange do not need to prioritize completing tiers beyond Tier 1. Communities with red hot spots should aim to complete Tier 2 and/or Tier 3.

3) Assign numbers to each hotspot as a reference for the next step. Label the darkest hotspot as #1 and continue to label each hotspot, with numbers increasing as temperature/color decreases (e.g.: red=2, orange=3, yellow=4, etc.).

4) Create an inventory of your municipality's hotspots. In your Word document, indicate each hotspot's number, color, address, and type (e.g. dark roof, parking lot, etc.). Record the hotspot Overall SVI Score and tree canopy coverage percentage.

5) Take a screenshot of each map layer (i.e. New Jersey Heat Map, Overall SVI layer, and Tree Canopy Cover layer) within your municipal boundaries and drop them into your Word document underneath each hotspot entry.

- After the hot spots have been identified, a field visit may be necessary to obtain more information regarding the cause of the heat, as well as opportunities for mitigating it. For example, the tree canopy map is at a relatively large scale and may not pick up individual trees. A site visit would reveal the type and pattern of existing trees and where gaps exist to plant new trees, or the condition of large, paved areas and whether they might be in need of repavement allowing for the introduction of trees or other interventions.

6) Present the Heat Island Assessment to the municipal Planning Board. Compile the information from steps 2-4 into a document or form that is sharable (e.g., word document, PowerPoint, poster) and synthesizes the assessment's findings. Present the Assessment at a Planning Board meeting, highlighting that the results can assist the municipality in meeting new MLUL requirements for the Land Use Element of a municipality's Master Plan.

TIER 2 (OPTIONAL - requires completion of TIER 1): Develop a Heat Island Mitigation Plan. (5 points)

Once the hot spots have been mapped and profiled, the next step is to develop a plan that includes actions for mitigating their effects. Action items will vary based on the type of hot spot, local conditions, and ownership. For example, a large, dark roof may require painting the roof white or applying another reflective surface. If the hot spot is a parking lot, the heat island could be mitigated by adding vegetation or repaving with a cool pavement. See "Typical Strategies" in the Technical Guidance for examples of heat island mitigation strategies.

The action plan should prioritize mitigation measures to protect public health and identify immediate opportunities. For example, hot spots located on or near a vulnerable community or buildings with known poor ventilation should be given high priority to protect public health. Hot spots on publicly owned property might be prioritized since the municipality has the ability to install mitigation measures. Educating both public and private property owners on local hot spots and mitigation measures is key towards the successful implementation of mitigation measures.

In addition to field visits, members of the Green Team tasked with completing the Heat Island Assessment should also seek knowledge of local residents and workers that can influence both mitigation strategy formation and strategy implementation. This could include, for example, whether or not air conditioning exists at the site.

See this action's Technical Guidance for a tutorial on preparing a Heat Island Mitigation Plan. At minimum, the

Heat Island Mitigation Plan should include the following:

1) **Heat Island Assessment**: A description of the heat island analysis results, including a list of the community's hotspots with relevant descriptions and maps. (Municipalities will compile this information when completing Tier 1 of this action.)

2) **Recommendations**: A list of recommended strategies to mitigate hot spots in the community and the rationale for their selection. Please be sure the recommendations indicate which of the local hotspots they are intended to address. Responsible parties and lead agencies, as well as a timeline for implementation should be identified for each strategy. This may include municipal departments, community organizations and/or regional agencies with expertise in community forestry, natural resources or open space management, public health, and communications and outreach.

- *Municipalities must demonstrate meaningful engagement when forming mitigation strategies for hotspots that affect vulnerable populations*. At a minimum, meaningful engagement in a municipal process or initiative means that all affected parties, especially those who are marginalized or vulnerable, are kept informed by the municipality and have appropriate opportunities to participate and/or provide feedback. It further requires that local concerns and recommendations will receive a considered response from the municipality. The Community Equity and Diversity Profile action explains how municipalities can identify and communicate effectively with marginalized and vulnerable populations.

3) **Monitoring progress**: Develop a system for measuring the progress in mitigating the heat island effects, including:

- Identify the local department, commission or committee that will be responsible for monitoring progress
- Create a sample list of issues and accomplishments that should be monitored, e.g. number/type of trees planted in or near hot spots, the number of green or cool roofs installed on buildings in hot spots.

TIER 3 (OPTIONAL - requires the completion of TIER 2): Implement one strategy located in the Heat Island Mitigation Plan. (5-10 points)

Communities that are severely impacted by the heat island effect will want to see action beyond assessment and strategic planning. In that case, Green Teams can work with their municipal governing body, Planning Board, and other relevant stakeholders to implement a minimum number of one strategy in their Heat Island Mitigation Plan. An additional five points are available if at least one of the implemented strategy(s) directly mitigates the heat island effect for socially vulnerable populations.

What to submit to earn points for this action

In order to earn points for this action, the following documentation must be submitted as part of the online certification application in order to verify that the action requirements have been met.

TIER 1 (REQUIRED) Heat Island Assessment: For 5 points, submit the following:

- **Description of Implementation**: In the text box provided on the submission page for this action provide a short narrative (300 words or less) of the following: which tier the municipality is applying for; and what data sources were used to identify hotspots, if not the Sustainable Jersey New Jersey Heat Island Map.
- **Upload: Heat Island Assessment**: The Assessment must include in one cohesive report the following:
  - The primary author(s) names and the date of completion;
  - A description of the heat island assessment and the number of hotspots identified, if any.
  - An inventory, including maps, of the community's hot spots with descriptions, including type, location, and considerations for tree canopy and social vulnerability.
- **Upload: Proof of presentation of the Heat Island Assessment to the municipal Planning Board** (copy of meeting agenda or meeting minutes).

TIER 2 (OPTIONAL - requires completion of TIER 1) Heat Island Mitigation Plan: For an additional 5 points, submit the following:

- **Upload Heat Island Mitigation Plan**: A list of strategies to mitigate heat islands, or hotspots, in the community. The Plan must include:

- A recommended mitigation strategy for each hot spot. More than one strategy for a hot spot may be appropriate if the strategies need to be further explored for costs and suitability.
- Responsible parties, lead agencies, and timeline for each recommended strategy. There may be more than one responsible entity for each strategy to address research vs. implementation.
- A brief description of how a strategy developed in a location with a socially vulnerable population was coordinated with their input.

TIER 3 (OPTIONAL - requires completion of TIER 2) Implement a Heat Island mitigation strategy. For an additional 5 points after the completion of Tier 2, submit the following:

A municipality will be awarded an additional 5 points for implementing a strategy identified in their mitigation plan.

- Description of Implementation: In the text box provided on the submission page for this action briefly describe which mitigation strategy has been implemented including a date when the activity was completed.
- Upload: Proof of implementation (photos, agenda items on municipal meetings, etc.).
- Upload Monitoring System: Identify the municipal office, department or individual who will be responsible for monitoring the progress of all mitigation strategies. Also include a summary of a recommended evaluation process to ensure success in carrying out the strategies outlined in the Plan and provide opportunities for continuous improvement. (The resubmission requirements will include evidence of progress with this plan.)

An additional **5 points - for a total of 10 points** - will be awarded if at least one of the implemented strategies directly impacts vulnerable populations.

- **Upload**: Alongside proof of implementation, a narrative description that includes relevant data points (SVI Score, Tree Canopy Cover percentage, etc.) that synthesizes how the location of the implementation addressed the needs of a vulnerable population.

Resubmission Requirements

Prepare and upload a report that documents the progress of implementing mitigation strategies for each of the hot spots. Where little or no progress has been made, indicate the reasons for poor progress and the strategy for overcoming obstacles and the addition of new hot spots and strategies. Forward the above report to the governing body, Environmental Commission and Green Team and provide evidence of the communication.

Actions submitted after January 2023 must use land surface temperature data dated during or after Summer (June, July, August) 2022. Action resubmissions submitted after January 2023 DO NOT have to have to include updated land surface temperature data if original assessment was completed between 2018-2022.

Approved Action Expiration Date

The approved action will expire 5 years after the date of the assessment, mitigation plan and or approved implementation. Municipalities can only be approved for a mitigation project and the possible bonus points once.

IMPORTANT NOTES:

There is a limit of six uploaded documents per action and individual files must not exceed 50 MB. Excerpts of relevant information from large documents are recommended.

All action documentation is available for public viewing after an action is approved. Action submissions should not include any information or documents that are not intended to be viewed by the public.

Gold Star Standard

Successful completion of this action will meet the requirement of an Additional action for earning a Gold Star in Health. For more information on earning a Gold Star in Health see the Gold Star Standards section of the website.

Spotlights: What other municipalities in NJ are doing

Newark
In 2017, the City of Newark released its Urban Heat Island Assessment. The list of identified hotspots in the City was created in partnership with Sustainable Jersey and with grant funds provided by the Prudential Foundation. The Assessment catalogs 12 hot spots located around Newark, including land surface temperature maps taken from the SJ Heat Island Map. A Mitigation Plan (starting on page 19) lists strategies for each identified hotspot.

Resources

The following resources may be helpful in completing this action.

Planning for Urban Heat Resilience - American Planning Association

Climate Change and Extreme Heating Events - Centers for Disease Control and Prevention (CDC)

Municipal Management of Extreme Heat - Delaware Valley Regional Planning Commission

Heat Island Explainer - MIT Climate Portal

Building a Climate-Resilient City: The built environment - Prairie Climate Centre

Community Equity and Diversity Profile - Sustainable Jersey

Excessive Heat Events Guidebook - U.S. Environmental Protection Agency (EPA)

What You Can Do to Reduce Heat Islands - U.S. EPA

Heat Island Cooling Strategies - U.S. EPA

The Urban Heat Island Effect and Land Surface Temperature in New Jersey - New Jersey Department of Environmental Protection

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Endnotes

[1]New Jersey Department of Environmental Protection. 2020. New Jersey Scientific Report on Climate Change, Version 1.0. (Eds. R. Hill, M.M. Rutkowski, L.A. Lester, H. Genievich, N.A. Procopio). Trenton, NJ. 184 pp.

[2]Ibid.

[3]Ibid.

[4]Ibid.

[5]https://ghhin.org/heat-and-health/

[6]Johnson, Richard J., Laura G. Sánchez-Lozada, Lee S. Newman, Miguel A. Lanaspa, Henry F. Diaz, Jay Lemery, Bernardo Rodriguez-Iturbe et al. "Climate change and the kidney." Annals of Nutrition and Metabolism 74, no. 3 (2019): 38-44.

Wesseling, Catharina, Jason Glaser, Julieta Rodríguez-Guzmán, Ilana Weiss, Rebekah Lucas, Sandra Peraza, Agnes Soares da Silva et al. "Chronic kidney disease of non-traditional origin in Mesoamerica: a disease primarily driven by occupational heat stress." Revista Panamericana de Salud Pública 44 (2020).

[7]Howe, Peter D., Jennifer R. Marlon, Xinran Wang, and Anthony Leiserowitz. "Public perceptions of the health risks of extreme heat across US states, counties, and neighborhoods." Proceedings of the National Academy of Sciences 116, no. 14 (2019): 6743-6748. https://www.cdc.gov/disasters/extremeheat/index.html

[8]Hsu, Angel, Glenn Sheriff, Tirthankar Chakraborty, and Diego Manya. "Disproportionate exposure to urban heat island intensity across major US cities." Nature communications 12, no. 1 (2021): 1-11.

Kim, Ella J. "The impacts of climate change on human health in the United States: A scientific assessment, by us global change research program." Journal of the American Planning Association 82, no. 4 (2016): 418-419.

McDonald, Robert I., Timm Kroeger, Ping Zhang, and Perrine Hamel. "The value of US urban tree cover for reducing heat-related health impacts and electricity consumption." Ecosystems 23, no. 1 (2020): 137-150.

Weinberger, Kate R., Daniel Harris, Keith R. Spangler, Antonella Zanobetti, and Gregory A. Wellenius. "Estimating the number of excess deaths attributable to heat in 297 United States counties." Environmental Epidemiology 4, no. 3 (2020).

[9]Deschênes, Olivier, Michael Greenstone, and Jonathan Guryan. "Climate change and birth weight." American Economic Review 99, no. 2 (2009): 211-17.

Poursafa, Parinaz, Mojtaba Keikha, and Roya Kelishadi. "Systematic review on adverse birth outcomes of climate change." Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences 20, no. 4 (2015): 397

[10]Ha, Sandie. "The Changing Climate and Pregnancy Health." Current Environmental Health Reports (2022): 1-13.

[11]U.S. Energy Information Administration. (2021, October 21). New Jersey State Energy Profile. New Jersey Profile. Retrieved September 1, 2022, from https://www.eia.gov/state/print.php?sid=NJ.

[12]Visit http://asm-air.com/airconditioning/much-cost-run-air-conditioner/ to learn more about how to calculate the cost of a home air conditioner.

[13]Akbari, H. 2005. Energy Saving Potentials and Air Quality Benefits of Urban Heat Island Mitigation (PDF) (19 pp, 251K). Lawrence Berkeley National Laboratory.