# 19-101 Introduction to Engineering and Public Policy
# Amazon HQ2 and Pittsburgh's Climate Action Plan

| | Section Weight | Report Score |
|---|---|---|
| Title/Scoring page: include this sheet along with report title and project authors' names and contributions on reverse. | 2 | |
| Introduction: introduce the problem, the task you were assigned, & a brief description of what is to follow in the report. | 10 | |
| Background: discuss HQ2 infrastructure and transportation needs, and impacts (generally) on Pittsburgh and the region. Identify stakeholders in the process, and any institutions that would be involved in moving forward. | 10 | |
| Transportation Evaluation: describe how you calculated transportation needs and give the results. Provide your evaluation of the transit needs. | 20 | |
| Infrastructure Evaluation: describe how you calculate the estimate of building and parking requirements and give the results, and the changes to neighborhood communities. | 20 | |
| Implications for Pittsburgh's Climate Action Plan: discuss the technical, social, and political challenges of having HQ2 enter Pittsburgh in relation to the CAP goals, and other considerations on behaviors and incentives. | 20 | |
| Report presentation: provide a professional report, with correct grammar, etc. Report has been proofread for errors. Writing is fluid throughout as if prepared by a single author. References are appropriately cited in the text and full citations provided in the bibliography. Graphical elements are appropriately styled. Appropriate significant figures provided. Scoring page. All pages stapled together. | 25 | |

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# Analysis of Amazon HQ2 and Pittsburgh's Climate Action Plan

## Introduction and Background

If Amazon's HQ2 were to come to Pittsburgh, it would bring in an influx of 50,000 new full-time employees and promises $5 billion in investment in the community. Amazon is seeking a headquarters space of over 8 million square feet and Pittsburgh has two prospective locations that fit their requirements: Hazelwood Green and Pittsburgh's former State Correctional Institution (SCI) (Amazon, 2017). Amazon's potential HQ2 employees, Pittsburgh city officials, and the current residents of Pittsburgh will all be deeply affected by the advancement of this project. The fact that Amazon recognized Pittsburgh as a lucrative opportunity is indicative of how far the city has come over the past decade in terms of innovation and prosperity. However, there are many factors to consider with regards to Amazon's interest in Pittsburgh. Along with that, there are many stakeholders involved in this process such as the Port Authority of Allegheny County, Amazon, Hazelwood Green, SCI and the people of Pittsburgh. In addition, it is important to consider what HQ2 will mean to the city of Pittsburgh and its climate goals. This analysis will focus on the effects of moving Amazon HQ2 to Pittsburgh, considering: transportation for 50,000 employees to the site, the configuration of the site's office space, and Pittsburgh's Climate Action Plan.

## Transportation Assessment

Hazelwood Green offers 178 acres of space for the headquarters and is within 4.2 miles of Downtown Pittsburgh (Google Maps, 2018). It is no stranger to spurring development, as it was a former steel mill site for the city. HQ2 would be settling in next to the Uber test track and CMU's Advanced Robotics for Manufacturing Institute. As for Pittsburgh's former State Correctional Institution (SCI), the site is located within 3.5 miles of Downtown Pittsburgh (Google Maps, 2018). The site will offer 120 acres once surrounding developments have been relocated. According to a news release by the corrections department, "the robust business community in Pittsburgh combined with the site's location, near transportation infrastructure and the industrial corridor, is optimal for reuse and revitalization of the site" (Gough, 2017). Both HG and SCI have viable attributes for the Amazon site.

The following section will perform an upper bound analysis in order to determine the existing capacity of a single bus route. In this analysis, three assumptions were made.

1. The morning commute applies to buses that leave between 6:30-9:30 AM
2. "To Downtown" is the sole direction of the morning commute
3. A bus has 50 seats, 75 people total including standing room.

We know that 8 buses leave on the 56 route between 6:30 and 9:30 AM. If each bus can hold 75 riders, the capacity during the morning commute for the 56 route bus is **600 riders** which was calculated from the quantity and capacity of the buses leaving within that time slot.

Next, we will consider how the 56 or 17 bus routes should be expanded to accommodate HQ2 at either the Hazelwood Green or SCI Pittsburgh locations. The following assumptions are made:

1. 100% of the 50,000 Amazon employees will ride a bus to work
2. Commuters are split evenly among the available bus routes per location

3. During the morning commute before HQ2 comes to town, buses are 100% full. Assuming that the Pittsburgh bus system already accounts for all existing Pittsburgh ridership, the number of additional buses simply shows Amazon ridership.

These aggressive assumptions create a scenario that describes the maximum amount of change to existing transportation systems.

The Hazelwood Green location has 3 available bus routes. Thus, the number of additional buses per route is calculated by dividing the number of additional riders by the capacity of these three routes (75 riders per bus). This results in an extra **223 buses per route.** The SCI Pittsburgh location has 2 available bus routes. Using the same method of calculation as was used for the Hazelwood Green location, this results in an extra **334 buses per route.**

This results show that each route serving the Hazelwood Green location would need around 220 additional buses to leave during the morning commute, and routes serving SCI Pittsburgh would need around 330 additional buses to leave during the morning commute. Considering Pittsburgh's existing bus fleet of around 700 buses, this would correspond to a 31% to 47% increase in buses. (Port Authority of Allegheny County, 2017). This addition of hundreds of busses would create strenuous traffic in Pittsburgh. It is necessary to look beyond the impact on Pittsburgh's public transportation system and also consider the effects of HQ2 on Pittsburgh's roads, bridges, and tunnels. If an additional 220 buses are added to the already congested traffic of the morning commute in Pittsburgh, the resulting transportation situation could be hazardous. This would be particularly noticeable on bridges and tunnels where vehicle congestion already causes stop-and-go traffic during rush hours. Making such drastic modifications to the bus system will only exacerbate the morning rush, along with costing Pittsburgh a substantial amount of money. It's clear that if Amazon wants to situate HQ2 in Pittsburgh, the city has to find a transportation solution to allow all 50,000 workers to commute without relying solely on their busing system. In addition, these modifications would have major ramifications with respect to increasing carbon emissions as they hamper Pittsburgh's Climate Action Plan, which we will detail in the following sections.

# Infrastructure Evaluation

In addition to managing how to transport all 50,000 Amazon HQ employees to HQ2, the city of Pittsburgh also has to assess different configurations of offices and parking garages in order determine how much space they take up and how much energy they consume. From this data, it is important to analyze whether these configurations are in accordance with Pittsburgh's Climate Action Plan. For the purposes of this analysis, we assumed that Amazon will aim to house all 50,000 employees within its office buildings and that they must provide parking spaces for at least 20% of employees (10,000 employees).

Amazon details that the company requires 8,000,000 sq. ft. of office space to house all of its employees (Amazon, 2017). In addition to this, Amazon needs to provide a parking space for its employees. Assuming a typical parking garage configuration of 330 sq. ft. per vehicle, Amazon requires 3.3 million sq. ft. in parking space (Kavanagh, 2015).

In order to determine the ramifications of various configurations, six types of building configurations were analyzed. Offices buildings were analyzed at an average of 3 floors, an average of 8 floors and an average of 16 floors while parking garages were analyzed at 5 floors and 10 floors. Open space percentage was determined by the percentage of the site that Amazon has free to use as green space (Aiello, 2010). In addition, to calculate the total energy

consumption of the office space, we multiplied data for the energy intensity per square foot of buildings over 500,000 square feet by the square footage of Amazon HQ2 to give a total energy consumption of 884 million BTU. (U.S. Energy Information Administration, 2015). However, since Amazon adopts the latest LEED design standards, the actual energy consumption from these buildings would be less than this number. To calculate the actual energy consumption, we looked at the energy reduction for each building dependent on the number of stories in the building. This data was collected from an analysis by Joshua Kneifel which simulates the effects of energy-savings design on the energy consumption of buildings. Finally, we gathered carbon savings data for these configurations also based on Kneifel's analysis (Kneifel, 2010).

**Table 1**: Data Comparison Across All Building Configurations

| **Building/Parking Config.** | **% Open Space SCI** | **% Open Space Hazelwood** | **% Energy Reduction** | **Actual Energy Consumption (millions of BTU)** | **% Carbon Savings** |
|---|---|---|---|---|---|
| 3 Stories / 5 Stories | 36% | 57% | 30% | 618 | 13% |
| 3 Stories / 10 Stories | 43% | 61% | 30% | 618 | 13% |
| 8 Stories / 5 Stories | 68% | 79% | 18% | 725 | 16% |
| 8 Stories / 10 Stories | 75% | 83% | 18% | 725 | 16% |
| 10 Stories / 5 Stories | 78% | 85% | 12% | 778 | 7% |
| 10 Stories / 10 Stories | 84% | 89% | 12% | 778 | 7% |

From this data, there seems to be a tradeoff between buildings configurations with more stories and building configurations with less stories. For configurations with more stories, the energy consumption and carbon footprint is much larger, going against Pittsburgh's Climate Action Plan. However, taller buildings also take up less surface area, thus increasing the amount of green space available in accordance with Pittsburgh's Climate Action Plan. For buildings with less stories, the opposite is true. The specific ramifications of such a tradeoff with respect to Pittsburgh's Climate Action Plan will be detailed in the following section.

Qualitatively, these large buildings could impact the surrounding neighborhoods. The Hazelwood Green site is located right between a residential area and the Monongahela River. The construction of tall office buildings would obstruct residents' views of the river and the scenery on the other side. In addition, Amazon HQ could serve as a major source of light pollution during the night, especially with the office buildings dominating the local skyline. The SCI location also faces a similar problem, as many residential communities have grown around the area and appreciate the neighborhood atmosphere. Having these large structures come out of nowhere and take over the local community could be jarring and unpleasant to those who like the suburban feel of the area. Paired with the consequences of these buildings with respect to Pittsburgh's Climate Action Plan that were detailed above, the city of Pittsburgh needs to carefully consider whether HQ2 will be beneficial or not.

## Implications for Pittsburgh's Climate Action Plan

Pittsburgh's Climate Action Plan 3.0 (CAP) focuses on six key areas: Energy Generation & Distribution, Buildings & End Use Efficiency, Transportation & Land Use, Waste & Resource Recovery, Food & Agriculture, and Urban Ecosystems (City of Pittsburgh, 2017). HQ2 will affect each of these categories in various ways.

Pittsburgh's CAP requires that new buildings be location efficient by 2030. The site must utilize space well, especially to accommodate ways of alternate travel to work (City of Pittsburgh, 2017). As we discussed in the transportation assessment, the increase in population caused by HQ2 will vastly compound the already failing transportation infrastructures in the city. Our transportation assessment determined that the Port Authority would potentially have to expand its bus fleet by over 31%, but it is unclear how that could be feasibly achieved; the proposed light rail system is only a far-off dream. Furthermore, the personal vehicles of HQ2 employees will generate additional congestion along highly-traveled routes. These additional vehicles will not only add to existing traffic but also increase emissions generated by on-road transportation. Pittsburgh's CAP also seeks to reduce emissions from on-road transportation by 50% below 2013 levels by 2030 (City of Pittsburgh, 2017). HQ2's effect on Pittsburgh transportation is exactly contrary to this goal.

In addition, Pittsburgh's CAP sets a goal of 100% renewable energy use by 2030 (City of Pittsburgh, 2017). If HQ2 comes to Pittsburgh, energy use will become a main point of concern. In many parts of the country, consumers are encouraged to switch from the gasoline vehicles to electric vehicles, a switch that is supposed to reduce the impacts of anthropogenic climate change. It is helpful that both the proposed sites are just on the outskirts of the city. This reduces emissions because vehicles will not need to cover as much distance and not as much energy is lost conveying electricity and natural gas to the site. However, electricity is only sustainable when its various energy sources are sustainable themselves. In most of western Pennsylvania, a large proportion of electricity is generated from coal, so switching from gas to electricity many actually increase net climate impact. The significance here lies with the massive quantities of electrical power that HQ2's servers and offices will consume, which we have estimated to be between 618 and 778 million BTU. Until Pittsburgh's electricity is sourced from renewable energies, HQ2's electricity use will increase Pittsburgh's climate footprint to a significant degree, creating negative externalities for surrounding areas and setting back the CAP's goal.

Pittsburgh's CAP also seeks to ensure that all new buildings are carbon neutral by 2030 (City of Pittsburgh, 2017). The CAP specifically calls upon city and state legislatures to adopt revised building codes. One of these codes seeks to limit building energy usage in order to ensure that buildings remain/become carbon neutral. However, from the infrastructure evaluation, there seems to be a trade-off between carbon reduction and green space (which would help offset carbon emissions), showing us that no building configuration would achieve this carbon neutral goal. In addition, as discussed above, limiting HQ2's energy use presents a significant problem to the Office of Sustainability. Amazon has stressed its commitment to sustainability. Its efforts to be more sustainable are evident in their implementation of energy-efficient lighting and a 'District Energy" system on the Seattle campus. Amazon also purchases large amounts of renewable energy (Amazon, 2017). However, their plan for an energy efficient site stops short of aligning with Pittsburgh's Climate Action Plan.

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