Giving Ithaca the Green Light
Necessary Updates for Improved Traffic and Air Quality

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An already green city...

Ithaca, New York has a widespread reputation as a city that is consistently progressing in its efforts to be considered sustainable. In fact, in 2007, Country Home Magazine ranked Ithaca as the number two “Best Green Place in America” based on sustainability standards that included power usage, farmers markets, and number of green-certified buildings (d’Estries). Since 2007, the city has taken actions to reduce greenhouse gas emissions by signing the US Mayors Climate Protection Agreement, which strives to reach a 7% percent reduction from 1990 carbon emission levels (“What is the US Mayors Climate Protection Agreement?”). Given this information, it is astounding to learn that the local Ithaca City Government is ignoring one simple step it can take to reduce poisonous vehicle emissions and decrease its amount of fuel usage: by updating its traffic light control system and creating a plan for better communication with the New York State Department of Transportation (NYSDOT), the local government would be implementing better traffic flow, reducing idling at traffic lights, and decreasing noxious pollution from fuel emissions.

...is in need of a green light

How can Ithaca keep up with its stride as an environmentally friendly city? In order to determine this, we must take a look at a two key problems that are currently taking place:

- Traffic jurisdiction issues in downtown Ithaca
- Air pollution from car exhaust builds up in the valley

Finally, a solution will be proposed that follows a recent axiom from the corporation, International Business Machines (IBM):

“Rethinking how we get from point A to point B means applying new technology and new policies to old assumptions and habits.” (“Smart Traffic”)

The solution will incorporate suggestions for better communication between the local and state governments, as well as give insight to technological advances in traffic lights that could potentially be put into practice in the future. Suggestions will also be prearranged for how the proposed solution can be effectively implemented through using outside organizations as a mediator and provider of policy and technology.

Traffic Flow

Driving down the side streets of the Ithaca Commons can prove to be a very tedious task. The closer one gets to State Route 13, the more congestion and idling at traffic lights the driver experiences. The consistent stalling results from conflicting traffic light jurisdiction:

the Ithaca City Government controls the traffic lights on all of the side streets, and the New York State Department of Transportation controls the traffic lights on State Route 13, Green Street, and Seneca Street. (Logue, December 11, 2009)

The two governments use two different systems of traffic light control and do not communicate with each other when creating their flow models. During a personal interview conducted with a New York State traffic engineer, Scott Bates, it was revealed that when NYSDOT updates their traffic plans for the Ithaca section of Route 13, they do so without consulting the local city engineers. Only later, after their models have been implemented in practice, do they provide the city of Ithaca with the data they have generated. As a result, the traffic lights for the local side streets and the State Route are not efficiently synchronized. Scott Bates agreed that while the streets in the area are overcrowded and therefore difficult to significantly improve, better intergovernmental communication would lead to an enhancement in traffic flow (November 19, 2009).

How it works... State Government

Currently, the state owned roads that run through Ithaca operate on a closed-loop system of traffic lights. According to Bates, this is the most efficient type of technology for the area. The operation of a closed-loop system is as such: at each intersection, there are detection pads underneath the street pavement. The detection pads are able to distinguish the magnetic field of the vehicles as they pull up to or pass by the intersection. The pads then send the data to a master controller light, which assists by communicating with the other traffic lights in order to keep the timing in sync. The statistics from the master controller are then sent to a computer, where a traffic engineer is able to analyze the information. This is helpful because the light becomes “smarter;” it can adjust itself based on the traffic patterns. Also, because the detection pads are able to count the number of vehicles that pass through the intersection, more data becomes available to the traffic engineers. With increased data, a better profile of the traffic patterns can be observed, allowing for better traffic flow models to be created (Traffic Signals and Traffic Flow: How They Work Together).
Even with the effective closed-loop system in place, NYSDOT is currently taking a progressive approach to the traffic plans for the Ithaca area of State Route 13. The reason for this update to the system is to address the increased congestion in the area. According to Bates, the state government is making plans to enhance the timing of the traffic lights, with a full arrangement created approximately by the end of February 2010. Bates is optimistic that the plan will be put into effect by the spring of 2010 (November 19, 2009). However, there has been no communication with the local city government about these plans. In an interview with local traffic light technician, Ronald Smits, it was revealed that the City of Ithaca Government has not been made aware that there are currently plans to update the traffic lights in the downtown area (November 30, 2009).

Furthermore, Tim Logue, the traffic engineer for the City of Ithaca, stated that the local city government had been pressuring the state government to make these advancements since 2007, and the situation is only now being addressed (December 11, 2009). Bates disclosed that once the plan has been completed, NYSDOT will then share its information with the city government, but will not enforce that the City of Ithaca make updates to its own traffic lights as a result (November 19, 2009).

How it works... City Government

The city government has taken a much more lax approach, which mainly appears to be due to a lack of funding and technology. In fact, according to Smits, just a few years ago the City of Ithaca didn’t even have an employed traffic engineer. The traffic lights in the Commons and the downtown area have been operating on a time-based system, which Smits feels is an efficient course of action.

The way this system works is that each traffic light has a set interval of time for each colored light. The controllers in the lights make it a very constant system; the timing does not drift and is occasionally tweaked in order to be sure that the clocks are running smoothly. There are three different intervals that city engineers has programmed: one for between 6:00am-10:00am, then 10:00am-2:00pm, and one for 2:00pm-8:00pm. The noon program runs overnight on weekdays and the evening system runs on the weekends (Logue, December 11, 2009).

While Smits stated that he believes this method is efficient, he would like to see a closed-loop system of operation for the local traffic lights (November 30, 2009). Logue agrees that it would be much more efficient to have a system where he could make changes remotely. Currently, in order to make changes to all of the lights, a technician has to individually change out each timer. If the timers could be accessed remotely, as they are when using a closed-loop system, changes could be made more quickly and more efficiently. However, the type of technology that would allow for quick advancements is outside the budget range of the local city government (Logue, December 11, 2009).

Air Pollution

According to the Department of Environmental Conservation (DEC), car exhaust is the major culprit of the emission of three important pollutants: carbon monoxide, nitrogen oxides, and hydrocarbons (“Controlling Vehicle Pollution”). The reason these three pollutants are significant is because when they combine in the lower atmosphere, they “bake” together to produce ground-level ozone (Figure 2). Ozone is a poisonous gas when inhaled and is the cause of several adverse respiratory symptoms that are observed over the general population, including:

- Decrement in lung function
- Inflammation of the airways
- Coughing
- Throat irritation
- Pain and burning of the chest when taking a deep breath
- Tightness of the chest
- Wheezing
- Shortness of breath

Children tend to be more susceptible to these effects because they breathe faster and take in more air per pound of body weight than adults do (“Ozone and Your Patients’ Health”). It has also been found that as cars idle, they emit more pollution due to an incomplete combustion that takes place within the engine when the car is not in motion. A 1995 study, performed by Dr. Robert Joumard, chairman of the French National Institute for Transport and Safety Research (“Influence of Driving Cycles on Unit Emissions From Passenger Cars”), shows that when cars are running at lower speeds or are in stop-and-go traffic, like when pausing at lights, the amount of emissions increases.

Mobile Source Emissions

In Tompkins County, New York mobile sources account for two major pollutants:

Carbon Monoxide
- 78% of total CO emissions
- 17,638 tons emitted annually
- 60th percentile dirtiest counties for CO

Nitrogen Oxides
- 24% of total NOx emissions
- 3,019 tons emitted annually
- 80th percentile of dirtiest counties for NOx

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![Image of Ithaca traffic lights]

- Traffic lights are green, indicating the traffic is flowing smoothly.
- Signage is visible, providing guidance for drivers.
- Pedestrian crossings are marked, ensuring safety.
- Traffic counts are monitored, allowing for efficient traffic management.

Ithaca, a city known for its progressive traffic management, is currently implementing a closed-loop system that will enhance traffic flow and reduce congestion. This system, designed by Ronald Smits, the local traffic engineer, will be put into effect by the spring of 2010 (November 19, 2009). However, the City of Ithaca has not been made aware of these plans, as the state government has not communicated with them.

How it works... City Government

The current system, which has been in place for several years, operates on a time-based system. Traffic lights change according to a predetermined schedule, which is not efficient in terms of traffic flow. The city government is interested in implementing a closed-loop system, but budget constraints prevent this from happening. Smits believes that a remote-access system would be more efficient and should be considered for the future.

Air Pollution

The major pollutants emitted from vehicle exhaust are carbon monoxide, nitrogen oxides, and hydrocarbons. These pollutants combine in the lower atmosphere to produce ground-level ozone, which causes respiratory problems. Children are particularly susceptible to these effects.

Mobile Source Emissions

In Tompkins County, New York, mobile sources emit significant amounts of carbon monoxide and nitrogen oxides. The city is working towards reducing these emissions to improve air quality and reduce health risks.
It is clear that our vehicles are emitting toxic pollutants in the downtown Ithaca area as a result of the poorly synchronized traffic lights. What makes this detrimental to the local community is that the topography of the area does not allow for the ventilation of the noxious fumes. One way that the pollutants can escape out and mix with the rest of the atmosphere is by dispersing horizontally over the land. However, the ill-adapted lights are located at the bottom of a valley, which is surrounded by hills. Upon examining the topography of the area, one can see that the lake is to the north of Ithaca, while raised land acts as a wall to the west of the city. To the east, south, and southwest of the city, a system of hills and valleys surround a portion of the downtown area.

**Mountain-Valley Breezes**

Because this type of topography characterizes Ithaca, the city experiences what is known as mountain-valley breezes, which prevent pollutants from escaping out horizontally. During the daytime, the sun heats up the surfaces in the downtown valley and along the sides of the mountains. This warm air rises along the hills, but becomes vertically trapped when it reaches the cooler air aloft, which prohibits the air from rising further. This causes the air to move horizontally over the valley, and then sink downwards, further prohibiting pollutants from rising upwards. In the evening, the reverse takes place. The surface cools after the sun has set, causing the wind to flow down the sides of the hills. In the valley, the winds converge and rise upwards. However, the cooler air aloft again prevents the air to continue traveling upwards (Barker). As a result, when pollutants are contained in the valley area, they are prevented from mixing effectively due to mountain-valley breezes. From examining the topography of the city, it seems as though the best way for pollutants to disperse horizontally is by escaping through the venous valleys to the east, southeast, and southwest.

**Low-Level Inversions**

In order for an area to experience an abundance of pollution, topographical impediments must not be the only blocking mechanisms that are in place. According to atmospheric research scientist, George C. Holzworth, "It is the simultaneous occurrence of limited horizontal and vertical mixing that is commonly observed preceding and during high levels of community air pollution." In order for vertical mixing to occur, the surface conditions must be unstable, which will allow for pollutants to continuously rise. This is a common occurrence, for it takes place when the sun heats the surface, causing the warm air to rise and the pollutants to travel upwards with the parcel of air (Holzworth). When there is a stable layer at the surface, the air is not significantly moving in the vertical direction, which makes it more likely that pollutants will not mix. Stability often tends to take place at nighttime, when the sun isn’t available to heat the lower levels of the atmosphere, but it can also take place when there isn’t significant heating occurring during the daytime. When the lower portion of the atmosphere is cooler than a layer of atmosphere directly above it, it is described as a temperature inversion. Low-level temperature inversions are the main reason why vertical mixing doesn’t occur. According to research done on low-level inversions, Ithaca, NY experiences conditions unfavorable for pollutant mixing between 25-35% of the time annually, with slightly higher frequencies in the summer and fall months. The most favorable time for vertical mixing in the Northeast is when the winds blow in from the Northwest or the West, due to the relative position to the Appalachian Mountains (Hosler).

**Seeking Solutions**

Because downtown Ithaca is susceptible to holding concentrated air pollutants from escaping, it is especially important that policy makers address vehicle emissions standards. Currently there are two major issues that have prevented our local and state governments from making necessary improvements: lack of communication, and lack of technology. While it is understandable that there may not be available funding for an advanced system of traffic lights, it would be very simple for the two governments to exchange ideas and information, especially by using the telephone and email messaging. A comprehensive plan for improved communication would ultimately lead to better traffic models and decreased vehicle emissions, and will be outlined as a part of the solution description.

**Planned Communication**

First, it is of utmost importance that the two governments communicate any updates to the Ithaca traffic light system with each other before and during the plan’s implementation. As previously stated, the state government shares its data with the city government only after its arrangements have been constructed. With an updated communication plan, should the state government decide to make changes to the traffic lights in Ithaca, the city engineers should first be alerted. In addition to notifying the city engineers of an upcoming advancement, the state government...
should also be prepared to share its model data with the local government. According to Scott Bates, the state creates their models by optimizing traffic flow on the streets they own (November 19, 2009). Should the city and state engineers combine their data early in the planning stages, it would be possible to optimize traffic flow using data from the local side streets in addition to those owned by the state, allowing for more efficient results. Also, because the current city traffic light system in place is very time consuming to update, early communication would give the city engineers additional time to prepare for any necessary local changes that may need to take place.

**Updated Technology**

As a result of increasing communication, more data becomes available to both parties. However, by updating the local technology, the city government would be able to more efficiently sync with the state government traffic lights and obtain further data that could potentially be helpful in creating future improvements. While funding may be scarce for the local government, the engineers have recognized that there are several benefits to installing “smart” detection pads, and made an investment to have them established. Just a few years ago, detection pads were placed in four intersections in downtown Ithaca, but due to improper installation, the detection pads are not currently being used (Logue, December 11, 2009). Because the expensive investment resulted as a failure, the city decided to stick with the time synchronization system.

**Closed-Loop Benefits**

Unfortunately, by sticking with the old technology, the city is missing out on the several benefits that are available when using a closed-loop system.

**Quantity:**
- Decrease travel time by up to 25%
- Reduces vehicle idling by up to 41%
- Hydrocarbon emissions can decrease by up to 10%
- Carbon monoxide emissions can decrease by up to 15%
- Fuel-consumption decrease by up to 13%

**Quality:**
- Updates monitored from a remote computer
- Maintenance expedited from automatic system failure detection
- Vehicle counting function increases the amount of data for engineers’ traffic optimization models

*(Traffic Signals and Traffic Flow: How They Work Together)*

**Advanced Technology**

Updating the traffic system to use detection pads is the simplest technological advancement that could be made to reduce idling, and therefore reduce pollutant emissions. However, urban engineering is hurdling forward in its innovation towards enhancing traffic flow. Through looking at a case study, one can see the many benefits a city gains from modernizing the traffic system. For example, the corporation IBM has recently executed several updates to the traffic network in Stockholm, Sweden, using advanced “smart” technology. The issue at hand was that Stockholm wished to reduce both the number of traffic jams in the city and the municipality’s air pollution levels—a desire that Ithaca, New York currently shares. Through using a charged toll system at peak congestion hours that is able to detect cars without a need for them to slow down, *traffic has been reduced by 22%*. In addition to traffic reduction, *vehicle emissions have been reduced by 14%*. According to Birger Hook, Director of the Swedish Road Administration’s traffic registry, “*The scheme is meeting the objectives set by the city of reducing traffic volumes, improving accessibility for buses and cars, and improving the environment.*” (*Congestion Pricing Cuts Stockholm Traffic by Almost a Fifth*)

Another development that IBM is looking into for Sweden is the implementation of *micro technology*. Microchips, which could be implanted in the tires of vehicles, would allow for cars to commune with one another (“Driving Innovation”). *This type of automobile interaction would be modeled after how ants communicate with one another.* Extensive research on ant communication shows that they serve as excellent optimized traffic models. When an ant is following a path, it emits a trail of pheromones behind it. Other ants are able to sense the pheromone path, and follow it. As a result, the path that is most often followed is often the shortest, most efficient path. That path will therefore have the strongest pheromones, and will linger the longest, providing the best route home for all of the other ants (“Go and Stop? Ant Traffic”). It is possible for cars to interact in a similar way using microchips, allowing people to obtain real-time information about traffic routes and adjust their paths accordingly. Experts believe that in the future, it is possible for the existence of automated highways where cars will be redirected to optimize traffic flow (“Driving Innovation”).

**Outside Mediation**

As previously stated, the city and state governments do not currently have the available funding for extremely advanced technology. A lack of financial support is just one obstacle that policy makers will face when dealing with the improvement of the traffic flow and air quality issues that Ithaca is facing. In order to surpass this hindrance, government officials must be willing to think creatively in order to implement feasible solutions. For example, the most imperative issue at hand is the communication between the local and state governments. In order for this issue to be resolved effectively, in addition to following a structured plan of the state alerting the city of its update plans before and during their creation, it may be necessary for an outside institution to act as a mediator. Currently, the best organizations to act as a link between the state and the city are the Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC).
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Environmental Protection Agency

The EPA is a federal establishment that is committed to protecting the health of the people as well as the environment. Because the local government and the state government do not have effective communication, it is possible that the New York Regional Office of Compliance could become involved in the situation. First, it would need to determine that the pollution levels in downtown Ithaca exceed what is legally environmentally acceptable. Currently, pollution is monitored on a large-scale regional basis, but because previously discussed local microclimatological factors play a role, more research would need to be conducted with further specific measurements for it is not currently available. Once it has been concluded that pollution levels exceed what has been set by the Clean Air Act, the EPA would then have to notify an infraction of policy, and a qualified inspector would be brought in to assess the situation and review current local and state policies (“Compliance Monitoring”). Because raised pollution levels from vehicle exhaust is the result of lack of communication between two government agencies, it would be likely that the EPA would look toward Alternative Dispute Resolution, which can be defined as “any procedure that is used to resolve issues in controversy, including but not limited to, conciliation, facilitation, mediation, fact finding, mini-trials, arbitration, and use of ombuds, or any combination thereof.” (“More About Civil Enforcement”) In this situation, the issue at hand is mediation, and the EPA would potentially act as a neutral third party and assist in drafting legislation for increasing governmental communication, and assist with allocating state funds to potentially provide the city government with necessary means for enhancing the local traffic technology. It would be bringing the issue at hand to the federal level, which could potentially be necessary based on the findings of the localized pollution level research, for it could ensure that proper traffic light technology funding is allocated to the city government.

Department of Environmental Conservation

Another outside agency that could potentially become involved is the NYSDEC. The NYSDEC specifically states in its mission that it wishes to prevent air pollution in order to enhance the overall well-being of the people (“About DEC”). Similarly to the EPA, the NYSDEC would need to assess the situation through research performed on the localized air pollutant levels. It would then be the responsibility of the NYSDEC to “draft, promulgate, maintain and enforce environmental regulations.” An environmental expert from the NYSDEC would create legislation that would address the air pollution situation, and seek input from the local community through open communication, which typically involves public hearing processes. Once a resolution has been reached, the NYSDEC would assist the local and state governments by offering guidance documents and training sessions. It would act as a mediator between the two governments and come up with an effective proposal for reducing vehicle emissions (“Regulation and Enforcement”).

International Business Machines

Another solution that could potentially allow for an advancement of technology would be to bring in an outside corporation that provides trial testing of traffic flow equipment. Currently, IBM is making strides in traffic technology, as previously discussed in the case of Stockholm, Sweden. It is feasible that the city and state traffic engineers could incorporate IBM’s traffic solutions into its own network of roads and highways on a volunteer basis. According to Scott Bates, when an outside corporation becomes involved, it would have to match up to the current technology in place (December 11, 2009). This would mean that as long as the technology provided can be integrated into the current system, it would be able to be used as an effective method for updating current technology in New York. Working with an outside institution would prove to be cost-effective for all of the parties involved. The corporation would be able to test initial trials of its technology, which for IBM include ideas for more efficient data collection through using tolls, cameras, parking meters, and fares (IBM: The Smarter City). The city and state would then be able to use these methods of data collection for updating their models. Ultimately, it is possible that using approved trial technology could be extremely beneficial for the reduction of vehicle emissions in Ithaca.

The green light... go!

Based on the evidence provided about excessive idling that has led to the emissions of toxic pollutants in the downtown Ithaca area, and given the local topography and climate surroundings, it is necessary for policies and technologies to be adopted to provide cleaner air and better traffic flow. The most immediately effective method for changes to be made to the current system is for the city and state government to communicate with one another before and during the implementation of traffic flow updates. However, because communication is not currently enforced, it may be necessary for an outside institution, such as the EPA or the NYSDEC to act as a mediator and require that the two government networks provide each other with essential information. Also, with traffic technology and data collection on the rise, it would be in the interest of the city to invest in better mechanical solutions, like looking towards using detection pads for a closed-loop traffic light system. In order to address funding, apart from involving the EPA or the NYSDEC, the local community also has the option to involve an outside corporation like IBM, which is currently testing new trials for data collection to improve traffic flow models. A long term plan for smarter traffic light technology and enhanced governmental communication will allow Ithaca, New York, to continue in its strides towards recognition as an efficient, environmentally sustainable city.
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Works Cited


