UNC INSTITUTE FOR THE ENVIRONMENT

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School Idling Reduction Team

"Idling Gets You Nowhere: Turn off Your Engine"

An Anti-Idling Toolkit to Raise Awareness and Reduce Private Vehicle Idling at Public Schools in Cumberland County, North Carolina

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ENST Capstone Class Spring 2010

School Idling Reduction Capstone

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Introduction & Background

Executive Summary

The objective of the spring 2010 UNC School Idling Reduction Capstone team was to investigate the problem of private vehicle idling at public schools and develop a program (particularly for Sustainable Sandhills and Cumberland County Schools) to mitigate the effects of this problem.

We addressed this task by first compiling a substantial amount of research on car idling at schools for our own knowledge and also to be appropriately included in our public awareness campaign. Our background research gave us information on the many effects of vehicle idling, as well as ideas for how best to structure our campaign. We chose to compile our materials into an "Anti-Idling Toolkit" to be used by schools and other interested organizations.

The toolkit includes three main components:

1. Public Awareness Campaign Materials
2. Curriculum Handbook (with activities for different subjects and grade levels)
3. Policy and Funding Information

The Public Awareness Campaign first includes initial steps for how schools might begin an anti-idling campaign. The steps include a timeline, sample letters to be sent out to parents/students, and a pitch to administrators. The campaign also includes sample documents and handouts to be used as a method of education and a pledge campaign to get people dedicated to turning off their engine. Finally, budget estimates are given so that users of the toolkit have an idea of cost estimates for printing the campaign materials.

The second core part of our toolkit is the Curriculum Handbook. The handbook includes a variety of activities to be used in schools or other places to educate people in an interactive manner. The handbook has activities for a range of subjects and grade levels. We believe people are more likely to be convinced to stop idling if they are engaged with the issue in a fun and educational way.

The third part of the toolkit comprises policy and funding options for schools or other organizations. The policy information gives a background of current policies in place around the nation to provide successful examples. The funding information gives information on government and non-governmental grant opportunities. Budget constraints are often a problem with initiating programs like this one, and we want to provide as much help as possible.

Finally, the next step is implementation. While we strongly believe in the materials we have compiled, they will only be successful if they are used! So, our hope is that our toolkit will be rightfully used to battle idling at schools in Cumberland County and beyond.

Background Materials

Community Background

Fayetteville, North Carolina, is adjacent to a major military installation, the U.S. Army's Fort Bragg. The Fort Bragg garrison is a leading force for sustainability in its community and region. The population of the area is transient, as employees of the army typically rotate in and out every two to three years. We worked closely with the Cumberland County Schools through our client, Sustainable Sandhills. Currently, the transportation budget of Cumberland County Schools is highly restricted. This is evident in the potential cost-saving measures that are being discussed, which include sharing bus drivers and having teaching assistants double as bus drivers. As for the future of public transit within the region, there is currently talk of constructing a multi-modal transportation center, with the primary goal of reducing traffic congestion in the area. Unfortunately, the communities of Cumberland County and Fayetteville are conflicted over this proposition, with much of the opposition stemming from the downtown merchants. Their hesitation arises from the potential demographic changes that may result from an improved public transportation system into the downtown area and the effects that such changes may have on their businesses.

Client Information

The client for our school idling reduction capstone is Sustainable Sandhills (SS), a non-profit organization that promotes environmental, social, and economic health in the greater Fayetteville area. Additional partners include members of the Combined Air Quality Team (CombAT), which assumes responsibility for short-term projects that raise awareness about air quality. Another partner is the Cumberland County district transportation coordinator. If our project is used for Sustainable Sandhills' participation in the Sustainable Skylines program, then the project could also potentially be linked with the Environmental Protection Agency (EPA).

Client Visit

On Friday, February 5, 2010, our work group met with client representatives, Jon Parsons and Heidi Johnson, to discuss our project parameters. We completed introductions and general discussions for an hour before traveling to Terry Sanford High School, with a population of about 1,350, to observe the end of school and the associated traffic and idling situation at this time of day. Idling appeared to be a problem on the western parking lot, where both student vehicles and buses encountered congestion, resulting in a high percentage of private vehicle idling. We observed cars backed up past the North Churchill Drive, Fort Bragg Road intersection. Additionally, buses were not at full capacity before departing, suggesting a potential area of improvement for an idling reduction strategy. It should be noted that we chose to observe the end of the Terry Sanford school day on a day with heavy rainfall, so our observations may not reflect the typical traffic/idling patterns of an afternoon with non-inclement weather.

Sustainable Sandhills has been working with the Environmental Protection Agency's Sustainable Skylines initiative to develop five programs to reduce emissions in the Sandhills

region. Our objective is to help Jon Parsons and Heidi Johnson develop one of those five projects as an anti-idling campaign for Cumberland County Schools, of which Fayetteville, and Terry Sanford High School specifically, are a part. Our purpose with this project is not to develop specific policy changes, although Sustainable Sandhills would welcome policy suggestions. They also indicated that the development of an anti-idling campaign toolkit would be helpful, as they could disseminate that information to Cumberland County Schools. Ultimately, our project will aim to find the most effective method to reduce idling, and thus improve air quality, at Cumberland County Schools. The suggestions must be flexible in order to fit appropriately in each individual school's unique physical layout and activity patterns.

Photos of our afternoon visit to Terry Sanford High School:









Existing Policy

The Combined Air Team (CombAT), a group of Cumberland, Hoke, and Harnett county air quality stakeholders, have been researching and surveying schools since the 2008-2009 school year to determine the best pilots for the program[1]. A UNC internship project in Fall 2009 investigated private vehicle idling habits at 10 schools in the district. The primary focus was to gather information regarding vehicle idling in county schools to determine the most effective strategy to reduce idling emissions. A "no-idling" policy for private vehicles has been implemented in Cumberland County Schools; however it has not been strongly enforced in its infancy. Beyond public awareness, changes induced by this policy have manifested in two no-idling signs at each school. Our goal is to develop a comprehensive no-idling policy that will be both easily understood and enforced by students, parents, and faculty.

[1] Find out more information about CombAT at www.sustainablesandhills.org/airquality.html

Background Research

This section contains background information pertaining to the adverse environmental, mechanical and health-related effects of private vehicle idling. The purpose of this section is to compile scientifically-based evidence as to why idling reduction should be an objective on every school's agenda, and the goal is to present this evidence such that it is accessible to for a variety of audiences. The material is broken into several components, including 1) a summary of the environmental, mechanical, and public health impacts of idling, 2) the same material presented in a bulleted format for presentation purposes, 3) a brief scientific literature review of the increased health risk that air pollutants pose to children, 4) a handout listing the major health hazards associated with common pollutants found in car exhaust, and 5) a handout containing calculations of total pollutants emitted during various school-idling scenarios. Each component may be utilized in whatever manner is most effective and useful for a given target audience.

Environmental Effects

Vehicular emissions are one of the most prominent anthropogenic sources of several human and environmental problems emerging from the post-Industrial Revolution world. The primary pollutants released from an automobile exhaust pipe are nitrogen oxides (abbreviated NO_x), carbon monoxide (CO), particulate emissions (primarily the fine particles designated $PM_{2.5}$), and volatile organic compounds (VOCs,), compounds such as formaldehyde and other hydrocarbons. Each of these emissions work both in isolation and in concert with one another to produce several negative human and environmental effects, including but not limited to irritation of asthmatic symptoms, global climate change, and ground-level ozone formation. Over 85% of emissions are released during the first few minutes of combustion, when the engine is just warming up to operating temperature. This scenario is referred to as a "cold start," a period when the engine has not warmed up to an optimum temperature for effective combustion (Baird and Cann).

NO_x is a potent greenhouse gas (GHG)—a group of gases that intercept outgoing shortwave radiation emitted from the Earth's surface and either reemit the radiation towards space or distribute the energy absorbed from the radiation as heat, heating up the air near the surface of Earth. This re-emission or redirection serves to warm up the temperature of the stratosphere, leading to potentially severe climatic changes. Beginning in the 1970s, all automobiles produced in the United States were equipped with catalytic converters that aimed to cut down vehicular emissions, primarily NO_x. The primary action of catalytic converters is to reduce the temperature of combustion in the engine; this works to reduce NO_x emissions because NO_x emissions increase as the temperature of combustion increases (Baird and Cann). It has been shown that idling a vehicle as a means to warm up an engine is an ineffective means to reduce NO_x emissions (Lenner, Lindqvist, Rosen). In particular, the concentration of NO_x emissions as NO_2 in the exhaust gases from an idle engine is some four times as high as the NO_2 concentration in exhausts from a car driven at 24.85 m hr^{-1}. Even with newer catalytic converters that are standard on most current automobiles, some of the NO_x produced from atmospheric N_2 during fuel combustion in automobiles is unavoidably converted to N_2O rather than to N_2 in three-way catalytic converters currently in use and is subsequently released into air.

A modern catalytic converter's functionality is not limited solely to reduction of NO_x emissions; they also serve to reduce the amounts of $PM_{2.5}$ and VOCs that are released from the exhaust pipe (Baird and Cann). VOCs, specifically hydrocarbons such as formaldehyde, serve as catalysts for the formation of ground-level ozone, O_3. Ethylene released from the exhaust pipe reacts with OH^- radicals present in the troposphere to produce a free radical compound. This radical compound reacts with diatomic oxygen, O_2, to produce a peroxy radical. This peroxy radical reacts with NO^- to form nitrogen dioxide, the most common form of the NO_x chemical family in the atmosphere. NO_2 undergoes photolysis to form NO^- and O^-:

$$NO_2 + h\,\gamma \rightarrow NO^- + O^*$$

with O* being a free radical form of atomic oxygen. It is this O* that combines with O_2 to produce ground level ozone:

$$O^* + O_2 \rightarrow O_3$$

Other free radicals generated from the reaction of the peroxy radical and NO- help to catalyze the creation of O3 by preventing the natural breakdown of the newly formed O3.

As mentioned above, cold starts occur when there is incomplete combustion within the engine (contributing to particular emissions); there is a direct correlation between the amounts of particulates emitted as a function of the fraction of vehicles that experience cold starts (Vizuete). Idling prolongs the cold start period for an engine, leading to increased amounts of PM2.5 and VOC emissions. Overall, idling increases the emissions of several environmentally hazardous pollutants, including NOx, PM2.5, and VOCs, that adversely affect climate and ecosystems.

Mechanical Problems

Economically, idling of vehicles is a damaging process, leading to several costly mechanical problems. Among the most notable are:

- Forces air through throttle plate when it is open only 3% (as it is during idling). Sample combustion equation for petroleum:
  - $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + energy

  Because combustion requires oxygen as a reactant, idling forces engine to use more fuel when idling due to lack of air (Mechanic)
- A popular misconception is that turning off and restarting a vehicle when stopped during a period of inactivity, such as sitting in a drive thru, consumes more fuel than idling it. The Tokyo Metropolitan Research Institute for Environmental Protection found that stopping the engine for a short time (from several seconds to a few minutes) reduced the fuel consumption of the gasoline vehicles, while idling vehicles continued to consume fuel during the idling process (Fujiharu, Hisashi, Kazuhiko, Masanao, and Shigeki).
- Oil contamination due to residue build-up on cylinders

- Corrosion caused by excessive condensation collected in external exhaust system
- Decrease peak engine operating temperature due to spark plug residue
- Damage to catalytic converter (totaling around $1600 for complete repair)

Health Effects

According to Dr. William Vizuete, professor of Environmental Engineering at UNC-Chapel Hill, there is a direct correlation between particular pollutant exposure from automobile exhaust and respiratory illnesses among individuals, specifically children and the elderly. CO, one of the prime emissions in car exhaust, is a molecule that bonds to hemoglobin in human lungs with a higher affinity than O_2, and with prolonged exposure leading to suffocation. Particulate matter of a small enough size (0.1-0.3 μm) can become lodged in the lungs and respiratory pathways leading to increased occurrences of asthma and other respiratory illnesses.

Children breathe 50% more air per pound of body weight than adults, thus making them particularly susceptible to the dangers of vehicular exhaust. A majority of young children are dropped off and picked up from school by parents or friends, and if any of these vehicles is idling during the drop off or pick up times, these children come into contact with the harmful chemicals spouting out of the exhaust pipe. Emissions such as $PM_{2.5}$ have shown increased effects of asthma in 7-8% of the population, especially for young children (Costa). This problem is not isolated just to young children, however, as many middle and high school kids are either ushered to and from school by parents or friends or take their own vehicles to school. In the case of schools with athletic fields and facilities located nearby main entrances and/or exits to the school, the increased breathing that accompanies many athletic activities would lead to an increase in the amount of air taken by the individual and thus greater exposure to automobile pollutants. In totality, any areas with a high concentration of emissions pose severe health risks to both children young and old.

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Children's Health Effects

Ambient air pollution in many cities around the world has reached levels that pose a significant threat to the respiratory health of their inhabitants. A large body of scientific research suggests that children and adolescents under the age of 18 are more vulnerable to the adverse health effects of these pollutants than any other age group. This literature review will synthesize some of the most recent and prevalent findings of the scientific community, hopefully emphasizing the importance of protecting children from exposure to any source of air pollution, including vehicular idling.

Respiratory illnesses associated with prolonged exposure to atmospheric pollutants tend to develop gradually over an extended period of time. Thus, one of the most effective methods for researching the chronic health effects of atmospheric pollutants has been the use of longitudinal studies, i.e., studies that monitor the health of a group of participants over a given time period. Multiple research studies of this nature have been conducted all over the world, many of which have found statistically significant correlations between exposure to ambient airborne pollutants and chronic respiratory illnesses in children. The longest of such studies ever recorded began in 1993 by scientists at the Keck School of Medicine at the University of Southern California, and it still continues today. The investigation, formally named the Children's Health Study (CHS), documented the pulmonary growth of 1759 children from schools located in 12 different southern California communities as they progressed from 4^{th} grade to 12^{th} grade (approximately ages 10-18). The communities were selected to represent a range of ambient levels of exposure to ozone, nitrogen dioxide, particulate matter ($PM_{2,5}$ and PM_{10}), elemental carbon, and acid vapor (inorganic and organic acids) . Typical of related studies, lung function (growth) was approximated by the forced expiratory volume per second (FEV_1), or the maximum volume of air that an individual can expel in one second. After eight years of monitoring, results were published in 2004, revealing statistically significant trends of decreased lung function growth for children in areas with higher ambient concentrations of nitrogen dioxide, acid vapor, and $PM_{2.5}$. The study also reveals that children living in an area with high relative ambient pollution as compared to an area with low relative ambient pollution face five times the risk of having critically low lung function—lung function at less than 80% of expected—by the time their lungs are nearly mature (18 yrs old) (Gauderman et al., 2004).

In a second study that developed as an offshoot of the CHS, scientists monitored the pulmonary development of 10-year-old children who had moved from one of the communities participating in the CHS to another community with different levels of ambient pollution. A total of 110 children were monitored for 5 years and were administered the same tests as children participating in the CHS. Avol et al. (2001) compared the health of these children with the average health of children still living their original communities, finding that subjects who had moved to areas of lower PM_{10} showed increased pulmonary growth, while subjects who had moved to areas of higher PM_{10} showed decreased pulmonary growth. They also found that the correlation between decreased lung function and increased ambient PM_{10} was strengthened by moving an area of high pollution at a younger age. This would suggest that the effect of ambient air pollution on lung function growth is cumulative (Avol et al., 2001). Both of these studies serve as strong, reliable indicators of the adverse impacts that ambient pollution has on childhood lung growth and function. Their strength lies in the fact

that they follow a large group of subjects over a long time period, and the data was collected in a consistent manner throughout the entire study. The major weakness of the study, however, is that it doesn't allow for any inference as to why children seem to be more susceptible to air pollutants than are adults.

Evidence suggests that a combination of factors could put children at greater risk of pollution-related respiratory illnesses (i.e., asthma, bronchitis, etc). Such factors include the fact that children breathe in more air (and thus more pollutants) relative to their body size than do adults, and that children are capable of increasing their respiratory rate up to 50% more than adults during a strenuous physical activity (Kleinman, 2000; Mathieu-Nolf, 2002). However, a strong basis of research suggests that the trend is particularly linked to the fact that children's lungs are growing and developing while the fully mature lungs of adults are not (Mathieu-Nolf, 2002). In support of this claim, a study by Wang et al. (1993) found that pulmonary growth varies with a child's stage of growth. The study further concluded that pulmonary growth rate corresponds directly to height growth rate, and thus the majority of lung growth occurs during puberty—approximately 10-18 yrs old (Wang et al., 1993).
The results of Wang et al. (1993) complement the results of a study by Braga et al. (2001), which compares daily records of hospital admissions in São Paulo, Brazil for children in various age groups (ranging from 0 to 18 yrs) to daily records of ambient pollutants ($PM_{2.5}$, O_3, SO_2, CO, and NO_2). The study found that air pollution was positively associated with respiratory hospital admissions over all age cohorts, with the greatest correlation for children less than two years old and for adolescents between 14 and 19 years old. These results would seem to agree with Wang et al. (1993), as these two age groups tend to encompass the periods of fastest pulmonary growth in children and adolescents.

A similar study was conducted by Barnett et al. (2005) in a total of seven Australia and New Zealand cities. The study compared respiratory hospital admissions of children in three age groups (0-1, 1-4, and 5-14 yrs) to the relative levels of ambient air pollution. Again, the results indicate "strong and consistent associations between outdoor air pollution and short-term increases in childhood hospital admissions" (Barnett et al., 2005). The researchers further analyze the results to determine which air pollutants have significant impacts on children of a particular age group and what exactly these impacts usually are. Conclusive evidence linked increased ambient $PM_{2.5}$, PM_{10}, SO_2, and NO_2 concentrations to an increased percentage of respiratory disease in children of all ages (0-14 yrs), an increased percentage of pneumonia and acute bronchitis in infants and children less than 4 years old, and an increased percentage of asthma in children 5-14 years old. Again, the strongest correlation was found for adolescents (5-14 yrs) (Barnett et al., 2005).

In conclusion, a large body of scientific research exists that indicates a correlation between ambient air pollution and decreased lung function in children and adolescents. Children are most susceptible to the impacts of pollutants during the first year of life, and adolescents are most susceptible during puberty. Since lungs tend to be fully matured by the end of puberty, a possible implication may be that any damage suffered during childhood development may become permanent as an adult. The continuation of long-term longitudinal studies, such as the Children's Health Study, will be essential in determining how these effects carry on into adulthood. Until conclusions about long-term health effects can be made, any measure that can reduce children's exposure to ambient pollution should be taken.

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Overview of Research

Mechanical Issues

- It has been shown that idling a vehicle as a means to warm-up an engine is an ineffective means to reduce NO_x emissions
- Idling consumes more fuel than taking a warm-up drive
- Idling causes carbon build-up on the idle values and pistons
- Idling increases oil consumption and deposits unwanted oil on piston rings
- Idling can cause spark plugs to fail and can lead to oil getting into the combustion, both of which can lead to a damaged catalytic converter
- Idling only opens a car's throttle plate 3%, forcing the engine to burn more fuel to compensate
- Stopping an engine for a short time (from several seconds to a few minutes) reduces the fuel consumption of gasoline vehicles, while idling vehicles continued to consume fuel during the idling process
- **The Bottom Line? Idling increases your bottom line!**

Environmental issues

- Cold starts occur when catalytic converter is not warmed up
- When an engine's catalytic converter is not completely warmed up, more emissions are released
- Idling prolongs the cold start period for an engine, leading to increased amounts of $PM_{2.5}$ and VOC emissions
- Both NOx and VOCs are dangerous to the respiratory system and lead to ozone formation
- Ground level ozone is dangerous at any exposure level
- While catalytic converters help decrease NOx and VOC emissions, modern converters utilize chromium and copper to speed up warm-up period[1]
- Studies have shown these metal deposits also damage the respiratory system
- **The Best Option? Limit your time in the car!**
- **Have to drive? Take a quick drive to warm up engine and catalytic converter**

Human Health issues

- Children take in more air than adults per pound of body weight
- Athletes take in more air during physical activity
- As more cars idle, more pollution, particulates, and chemicals enter into the air
- As children and athletes take in more air around idling cars, they take in more pollution
- Studies have shown direct correlations between the amount of emissions entering and the rates of respiratory illness
- Emissions have shown increased effects of asthma in 7-8% of the population, especially for young children[2]
- So where does that leave us? Cars will emit harmful chemicals and pollution, but over 85% of these emissions are released before the catalytic converter is warmed up[1].
- **Solution? Take a warm-up drive and don't idle!**

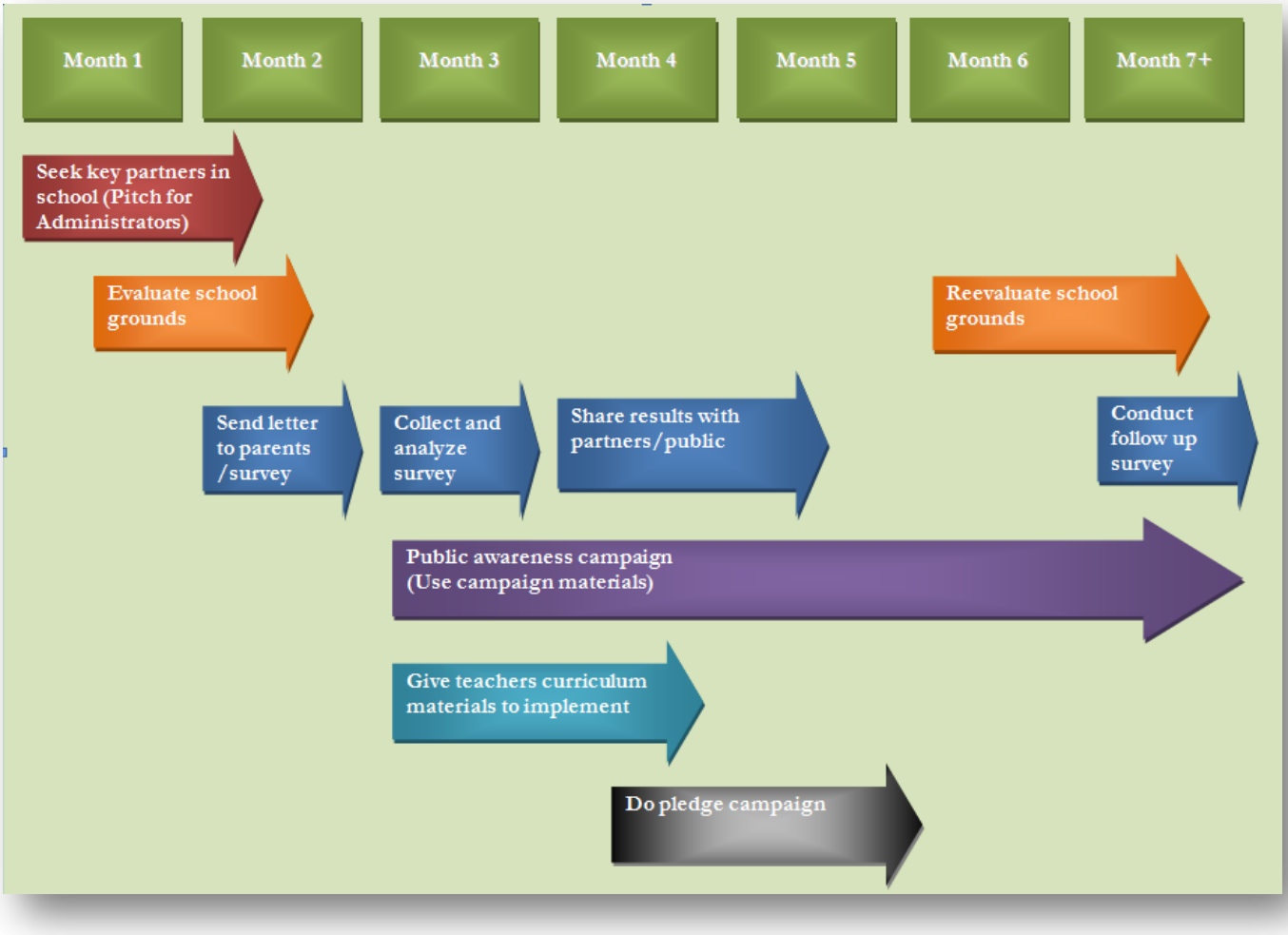
School Idling Reduction Toolkit

Toolkit Overview

This section contains the School Idling Reduction Toolkit, comprising a Public Awareness Campaign, Curriculum Component and Policy and Potential Funding Section.

Timeline for Toolkit

This is an example of how one individual school could implement the various aspects of the campaign.



Public Awareness Campaign Component

Overview

The Public Awareness Campaign Component includes instructions and materials on how to mount an anti-idling campaign at schools at each level: elementary, middle and high. This part of the toolkit has several pieces that can be used separately or together depending on the needs and resources of the school. Pieces of the toolkit are being developed so students can take a more active role in the campaign, encouraging participation that will in turn lead to positive results. Elements of the toolkit will be made available on the website being created for the project.

The Anti-Idling Campaign is based on a Community-Based Social Marketing model detailed by Doug McKenzie-Mohr in the article "Fostering Sustainable Behavior: Community-based Social Marketing." This is a pragmatic approach to changing people's behaviors by identifying barriers to sustainable activities and then introducing behavior change tools. Anti-idling behavior has positive environmental, health, and economic benefits, which this Public Awareness Campaign strives to promote through specific methods.

The Public Awareness Campaign aspect of the Anti-Idling Toolkit includes several phases with a variety of recommendations and potential activities. It should be tailored to the specific school and community. It is recommended to start with a smaller population (one or two schools) for an initial pilot of the program, and then to expand it based on initial challenges and successes.

Initial Steps

The goals of initial steps listed below are to seek key partnerships for the implementation of the Anti-Idling Toolkit and to identify barriers to sustainable behavior.

The School Ground Evaluation will provide direct observation concerning idling at schools. The survey will enable individuals to give specific information as to their behavior around school drop off/pick up and how concerned they are about school idling.

1. Conduct an initial School Grounds Evaluation to analyze idling situation at school.
2. Send out letter to administrators and potential partners.
3. Send out letter to parents with enclosed survey.
4. Collect survey data and analyze results to select proper campaign components.

School Grounds Evaluation

The purpose of the school grounds evaluation is for interested parties to understand the specific traffic patterns and the prevalence of idling at their specific school. By conducting this activity, individuals will be able to better understand transportation issues at school and why the implementation of the Anti-Idling Toolkit is a useful service for schools. This exercise can initially be conducted by interested parties within each school. Administrators, teachers, and students may be invited as additional participants in this activity.

Participants should monitor traffic on or around school grounds particularly during school opening/closing.

School Grounds Evaluation Checklist:

- ☐ Watch for cars at pick up and drop off areas –
  - Are parents waiting in cars?
    - If yes, are cars idling?
      - If yes, how many cars and for how long?
- ☐ Notice entrances, exits, and traffic patterns –
  - Do cars have to wait to enter/leave parking areas?
    - If yes, are cars idling?
      - If yes, how many cars and for how long?
- ☐ Observe the bus area –
  - Are the buses idling?
    - If yes, how many buses and for how long?
- ☐ Note where students are waiting for the buses and to be picked up –
  - Are they located near idling vehicles?
    - Is there noticeable air pollution in these areas (for example, based on smells of exhaust fumes, sight of pollutants, etc.)?
- ☐ Watch the parking lot after a special event (game, play, concert etc.) –
  - Does the parking lot clog up after the event?
    - If yes, are cars idling?
      - If yes, how many cars and for how long?
  - Why are the cars idling (waiting to leave parking lot, waiting to pick up students, etc.)?

Pitch to Administrators/Potential Partners

Use this letter to assist with gaining initial support from administrators and potential partners within the school, such as the PTA.

Dear Administrators/Potential Partner:

The threat to health posed by emissions from motor vehicles is a concern at schools, where children—who are particularly vulnerable to air pollution—spend much of their time away from home. At schools there is a high concentration of school buses and private vehicles as adults drop off and pick up children. This in turn creates an increased level of air emissions in the school environment. Although school bus idling has been reduced significantly (largely mandated by policy), idling by personal vehicles is increasingly recognized as a problem that merits scrutiny, awareness, and change.

Specifics about Idling:

- Idling a vehicle to warm up an engine has been shown to be ineffective for reducing NO_x emissions.
- When an engine's catalytic converter is not completely warmed up, more emissions are released.
- Idling prolongs the cold start period for an engine, leading to increased amounts of $PM_{2.5}$ and VOC emissions
- VOCs and NO_x found in car exhaust are directly related to the production of ground level ozone, a hazardous compound at any level of exposure
- Idling opens a car's throttle plate only 3%, forcing the engine to burn more fuel to compensate
- Stopping an engine for a short time (from several seconds to a few minutes) reduces the fuel consumption of gasoline vehicles, while idling vehicles continued to consume fuel during the idling process
- Children take in more air per body weight, and if idling occurs near children they will take in more harmful emissions than an adult

An Anti-Idling Toolkit has been created that includes a comprehensive set of materials to help Cumberland County implement an Anti-Idling Campaign in its schools. The toolkit includes:

1. *Initial Steps*
   - ✓ A recommended list of steps for schools to take including examining school grounds/exit patterns, surveying interest parties, and materials to seek support.
2. *Public Awareness Campaign Materials*
   - ✓ Materials to raise awareness of the impact of idling and local policies concerning the practice. Instructions for mounting a coordinated and effective anti-idling campaign included.
3. *Policy Options*
   - ✓ A set of potential policy options that schools can utilize, including pros and cons of different policies based on relevant programs, both locally and nationally, already in place.

4. *Curriculum Components*
    - ✓ A handbook of activities in four different subjects (math, English, science, and art) for elementary, middle, and high school levels to educate students at all grade levels.
5. *Potential Funding Options*
    - ✓ A list of possible funding and grant recommendations to decrease the burden on your school of implementing the campaign.

Please join [Insert Partner Name] as we seek to protect student health and provide a better learning atmosphere at schools.

Sincerely,
[Insert Partner Name]

Letter Home with Students

Place this letter in a school paper or newsletter; or hand out to students. This letter can be accompanied by an initial survey (example included) about idling and transportation behavior.

Dear Parents/Guardians:

Idling by cars and buses is a problem at our school. Children—who are particularly vulnerable to air pollution—spend much of their time at school. When there is a high concentration of personal vehicles and buses idling on school grounds, toxic emissions are increased, creating an unhealthy outdoor environment at schools. Although school bus idling has been reduced significantly (largely mandated by policy), idling by personal vehicles is still a problem that merits scrutiny, awareness, and change.

Specifics about Idling:

- Idling a vehicle to warm up an engine has been shown to be an ineffective to reducing NO_x emissions
- When an engine's catalytic converter is not completely warmed up, more emissions are released.
- Idling prolongs the cold start period for an engine, leading to increased amounts of $PM_{2.5}$ and VOC emissions
- VOCs and NO_x found in car exhaust are directly related to the production of ground level ozone, a hazardous compound at any level of exposure
- Idling opens a car's throttle plate only 3%, forcing the engine to burn more fuel to compensate
- Stopping an engine for a short time (from several seconds to a few minutes) reduces the fuel consumption of gasoline vehicles, while idling vehicles continued to consume fuel during the idling process
- Children take in more air per body weight, and if idling occurs near children they will take in more harmful emissions than an adult

How you can get involved:

1. Fill out the attached survey concerning your knowledge and opinions of car idling and transportation behavior. Your response will help our school create a campaign to effectively solve this problem.
2. Look out for anti-idling information that will be given out in the future.
3. Talk with other parents about idling. Pass along the message to stop car idling on school grounds.

Please join us as we seek to reduce the level of idling at our school and provide your child with a healthier school atmosphere.

Sincerely,

[Insert School Principal or Other Official Name]

Initial Steps Survey

This part of the Anti-Idling Toolkit is a method by which individual schools can kick start their own anti-idling campaign. The survey asks both general and more specific questions about the parent or student's perception of the issues of private vehicle idling, air pollution, traffic congestion, safety, and transportation options at their school.

One of the necessary first steps to enacting any kind of change to combat car idling is first to find out the school population's perception of the situation and their willingness to accept changes at the school. If the survey receives ample feedback and the results are used properly by school faculty, the survey could be a great tool for getting a grasp of the school's biggest areas of concern and how to fix them. Based on the answer feedback to the questions, the survey will direct the school in choosing from different options and developing a range of procedural, policy, and curriculum solutions specifically tailored for their own school.

Included is a sample survey that can be duplicated for either online surveying or distribution through the letter sent home to parents.

Prompts

Explicit prompts (such as the Toolkit Slogan: "Idling gets you nowhere. Turn off your engine.") are effective means of encouraging sustainable behaviors. It is important that prompts are delivered close in time and space to people making decisions concerning the behavior. Below are some ideas for how to utilize the prompt materials provided in the Anti-Idling Toolkit:

1. Post fliers in hallways and parking lots.
2. Place on the back of all Exit doors as a reminder when individuals leave school.
3. Post in areas where students and parents wait after events (lobbies, hallways, near gyms, auditoriums etc.).
4. Place as advertisements in school newsletters, athletic/drama programs, PTA newsletters, on the school website, school newspaper, etc.)
5. Make rearview mirror hangers and distribute to student drivers and parents. (Option to make mirror hangers an enforced policy for student drivers at high schools)
6. Make prompts into magnets, bumper stickers, or handouts to distribute to students, parents, and faculty.

Budget Estimate

In creating this campaign we felt it was necessary to do some research on how much it would cost to produce the materials we suggest using. The following is an estimate given to us by Jean Moore of Moore Exposure (jean@mooreexposure.com). The costs we estimated should be used as a guide when applying for grants to fund the campaign.

Moore Exposure:
Location: 215 Williams St., Fayetteville, NC 28301
Phone: (910) 486-8021
Fax: (910) 486-7888

Fliers:

200 5.5 x 8.5 fliers - $83.26 (digital print) (200 is max. cut-off for digital print)
500 5.5 x 8.5 fliers - $106.95 (4-color) (500 is min. cut-off for 4-color)

200 8.5 x 11 fliers - $149.88 (digital print)
500 8.5 x 11 fliers - $232.32 (4-color)

Pledge cards

250 5.5 x 2 pledge cards (full color front/blank back, perforated) - $141.45
500 5.5 x 2 pledge cards (full color front/blank back, perforated) - $143.56 (same deal with digital and 4-color)

Bumper stickers:

250 7-1/2 x 3-3/4 two-color bumper stickers - $248.00
500 7-1/2 x 3-3/4 two-color bumper stickers - $318.00

250 11-1/2 x 3-3/4 two-color bumper stickers - $251.50
500 11-1/2 x 3-3/4 two-color bumper stickers - $345.50

Keychains:

300 2-5/8 x 2-1/2 rectangular keychain made from recycled tires - $270, $35 setup charge
500 2-5/8 x 2-1/2 rectangular keychain made from recycled tires - $430, $35 setup charge

Posters:

250 11 x 17 posters (full color front/blank back) - $240.62
500 11 x 17 posters (full color front/blank back) - $367.50

250 18 x 24 posters (full color front/blank back) - $651.88
500 18 x 24 posters (full color front/blank back) - $691.25

Pledge Campaign

Research studies show that individuals who commit in writing to a sustainable behavior are more likely to actually practice that behavior. Seeking public commitments, or in group settings, are effective means to increasing participation and encouraging accountability. Asking individuals to commit to small requests (such as not idling their cars outside of schools) often prepares individuals for larger requests (for example, if the school wants to later implement a staggered dismissal policy).

Thus, the toolkit includes a pledge campaign, which will allow for a public display of pledges by devoted parents, students, and faculty. This should be implemented early in the campaign. See following page for example pledge card.

Steps:

1. Send home pledge cards with students for both parents and students to sign. See following page for example of pledge card.
2. Find a public space within the school to hang up signed pledge cards.
3. Encourage involvement in pledge campaign by keeping track of participation (for example, by class or grade) and give an award to the winner of highest participation.

Handouts

Included after the pledge card example are two handouts that can be used to share information about idling. These can be given to students at school or sent home with parents.

Idling Gets You Nowhere. Turn off your engine.

Pledge Card

Sustainable Sandhills

I _____ pledge to:

1. Limit idling time in loading and unloading areas.
2. Turn off my engine in the school yard whenever possible.
3. Learn more about idle reduction programs and policy in my school district.

Signed: _____

Date: _____

School District: _____

City and State:_____

Curriculum Component

Enclosed is the preliminary curriculum materials designed to familiarize and educate children regarding idling. It is broken into grades 1-5, grades 6-8, and grades 9-12, with middle and high school assignments having potential for overlap depending on the children's' education level. Each of these grade level partitions will be further divided by subject for easy accessibility and cross-referencing. All of the assignments were designed to teach children about the environmental, health, and social consequences of idling in order to convince them, their teachers, and their parents to commit to behavioral changes. Overall, students will be familiarized with the topic of idling through its integration into all subjects at all grade levels, whether it is in math problems, arts and crafts assignments, science experiments or grammar practice.

Five art assignments have been compiled for each group, allowing for a variety of materials and media. Approximately five science exercises and experiments were assigned to each grade level, specifically providing for biology, chemistry, physics, and environmental science at the high school level. Five to seven language arts exercises, ranging from sentence structure to complex essay prompts, were created for each level of schooling. Three math problems were developed for each level of math: addition/subtraction, multiplication/division, geometry, pre-calc, pre-algebra, statistics, and calculus. In addition, an activity book with basic and fun exercises was created for children in grades 1-5 to engage them in the topic.

Although these assignments have been based off of lesson plans normally used for these grades and subjects, they were all created by students without teaching experience (unless otherwise noted). Therefore, difficulty and context should be similar to existing assignments, with only the rhetoric having changed in most instances to maintain existing educational goals and standards. All assignments are designed to be templates, in order to show teachers- with more experience regarding what is appropriate for their class- how to incorporate the language of idling into their subjects. However, if deemed to be appropriate, these assignments may certainly be used in the classroom.

Policy & Potential Funding Options

Policy Overview

Policy changes represent concrete products of a successful campaign, and, perhaps more importantly, they provide a means for the ideological changes advocated by the campaign to transform into visible changes in practice. Accordingly, some form of policy change should always be included as part of the long-term goals of any campaign. However, problems arise given the complexity of the various processes involved in getting a policy change proposed, approved, and ultimately implemented. In the case of this Capstone project, the time period within which we have to accomplish our goals is limited to only a few months, thus making any realistic shot at implementing a successful policy change by the end of the project out of reach. That being said, we still consider policy changes as an essential long-term goal of this anti-idling campaign, but with the key distinction that this goal will be indirectly accomplished well after the capstone project ends and only with the combined efforts of parents, school boards, elected officials, and other outside supporters of the campaign. Accordingly, this project will focus on a more feasible, short-term aspect of this long-term goal—researching, creating, and proposing future policy recommendations. These recommendations, we hope, serve as a catalyst for the policy change process, particularly by providing a jumping-off point for outside parties.

The list of policy recommendations that we create must be carefully constructed, as the policies should be realistic, practically applicable, and, most importantly, successful at reducing idling on school grounds. Although every school faces a unique set of problems involving idling emissions, our goal is to create a list of policy recommendations that would be generally applicable to broad categories of schools based on the causes of the idling problems they face. Thus, creating this list will first require substantial research into existing policies on the local, state-wide, or even national levels. The next step would be to determine which of these existing policies could be used as an example for other schools to adopt, and to modify these policies for the general cases. It will also be necessary to research exactly how policy changes are generally made on the local, regional, state, and possibly national levels, as a better understanding of the processes will result in a better comprehension of the possible results.

The policies found below represent vehicle idling reduction policies on multiple scales from school-based to the state government. Research was conducted in order to find policies that have shown significant impact in terms of school-based idling reduction as well as applicability to Cumberland County schools. Some policies provide a campaign framework that could be used as a model for schools in Cumberland County while others provide helpful information or a contact organization. This is by no means an attempt to summarize all existing anti-idling policies, but to provide a brief and diverse list to aid in searching for anti-idling policies.

Potential Policies

Policy: Walking School Bus Campaign
Description: Alternative to motor vehicle transport, a walking school bus is a group of students who walk to school with one or more adults.
Cost: Minimal monetary cost; takes planning, organization and commitment from parents.
Benefits: Quality time spent between parents and children, gas money saved by parents and schools, healthy exercise for children and adults
Challenges: May not be feasible based on location of school and where students live. There are also safety issues with regard to having students walk to school rather than ride a bus.
Resources: <http://www.walkingschoolbus.org/>

Kearns, R., & Collins, D. (2003). Crossing roads, crossing boundaries: empowerment and participation in a child pedestrian safety initiative. Space & Polity, 7(2), 193. <http://search.ebscohost.com.libproxy.lib.unc.edu/login.aspx?direct=true&db=aph&AN=11123233&site=ehost-live>.

Policy: Smart Bus Practices
Description: This includes a variety of practices that a school can adopt in order to ensure that buses are being used in a fuel efficient manner. These include following maintenance procedures, assigning newest buses to the longest routes and encouraging drivers not to caravan too closely.
Costs/funding options: Minimal.
Benefits: These policies are simple steps that can effectively improve air quality surrounding schools and near children.
Challenges: These policies may need to be implemented through the transportation department rather than by individual schools.
Resources: < http://www.epa.gov/cleanschoolbus/>

Policy: Create inside waiting space for bus drivers.
Description: With bus idling no longer allowed based on Cumberland County policy, this simple tactic will help bus drivers stay comfortable if they have a long wait between routes.
Costs/funding options: None found for specific purpose.
Benefits: Bus drivers have less incentive to idle and can stay comfortable.
Challenges: May be difficult to find space or bus drivers may not want to leave buses.
Resources: No specific examples found.

Policy: Move student waiting areas away from where cars idling and buses wait.
Description: This simple tactic protects students' health by moving where students wait for buses/pick up. Although it may be impossible to completely eliminate idling, this policy will help reduce harm by moving the area where children are allowed to wait for transportation.
Costs/funding options: Minimal. Students may need adult supervision in different area or help communicating to students when their rides arrive.
Benefits: This instantly reduces harm by moving children away from increased pollutants.
Challenges: School may not have an area removed from cars but still within sight of transportation options. This may make it difficult for students to find their rides and may require adult supervision to facilitate this process. There could also be safety concerns depending on the physical layout of the school and where students wait.

Policy: Special Events Traffic Management
Description: This set of policies will allow for specific schools to create a set of procedures and tools which will help decrease parking lot congestion and thus idling after special events (games, plays, concerts etc.). These policies could include: staggered exits after events, parking lot attendants directing traffic, and changing parking lot flow (all lanes exit etc.) after events.
Costs/funding options: Costs will vary greatly depending on explicit policy chosen for implementation. Staggered exits after events is virtually free, while having a parking attendant or changing flow may have associated expenses.
Benefits: These policies will help to reduce idling after school events, thus helping maintain air quality around the school.
Challenges: May cause some inconvenience for school visitors/attendees to events.
Resources: Victoria Transport Policy Institute. <http://www.vtpi.org/tdm/tdm48.htm>
Victoria Transport Policy Institute. "Special Event Transport Management." <http://www.vtpi.org/tdm/tdm48.htm>

Policy: Staggered School Dismissal Bells
Description: This policy creates staggered dismissal by having different bells for walkers, bus riders, and carpoolers. Walkers could leave first in order to avoid congestion and excessive pollution. Bus riders would leave after several minutes. They would be able to efficiently find buses and leave the school grounds. Finally, students who ride in cars would be dismissed. With many students already gone, this would alleviate some congestion and thus allow for less idling in the parking lot.
Costs/funding options: Minimal.
Benefits: This policy would help to alleviate congestion in parking lots with minimal cost.
Challenges: Students and parents may not want to deal with different dismissal times. This policy may be inconvenient for school administrators, teachers, and coaches.
Resources: No specific examples found.

Policy: NCDENR Idle Reduction Rule
Description: Still awaiting legislative review (hopefully passed in 2010). State legislators are attempting to develop an overarching anti-idling regulation restricting idle time to no more than 5 minutes within a 60 minute time period.
Costs/funding options: N/A
Benefits: State-backed anti-idling campaign with legal authority. Applicable all over the state (thus includes schools).
Challenges: Getting it passed before being too watered down. Oversight, enforcement, etc.
Resources: <http://daq.state.nc.us/rules/idle/>

Policy: Clean Air Zone Idaho for Schools
Description: Based off Clean School Bus USA and also applies to private vehicles. Developed by Idaho Department of Environmental Quality. Provides resources to school districts (access to funding, campaign materials, toolkit, etc.)
Costs/funding options: Access to state and federal funding
Benefits: Relatively extensive toolkit (available on internet)
Challenges: Unknown.
Resources:
<http://www.deq.state.id.us/AIR/educ_tools/clean_air_zone_idaho/index.cfm>

Policy: School Bus Retrofits and Idle Reduction (Minnesota Pollution Control Agency)
Description: Focused on School Bus Idle Reduction (legislation); however, include materials and resources for private vehicle idling reduction.
Costs/funding options: None within specific policy; however, possible funding from MPCA
Benefits: Success in School Bus Retrofit program.
Challenges: Lack of policy and legislation regarding private vehicle idling.
Resources: <http://www.pca.state.mn.us/air/schoolbusretrofits.html

Policy: Idle-Free Ambassador Program (BC and Canada)
Description: "Ambassadors" placed in select communities to promote idling reduction education and awareness on vehicular emissions. Has dual purpose of implementing idle reduction campaign as well as allow ambassadors to gain public policy experience.
Costs/funding options: B.C. Air Action Plan funding.
Benefits: Spark grass roots push for idling reduction within the community.
Challenges: Overcome people's habitual idling and idling myths.
Resources: Idle-Free Ambassador Program evaluation (attached)

Policy: Idle reduction programs for the Chicago metropolitan area
Description: One of two approaches of main idle reduction strategies involves increasing awareness and conducting anti-idling campaign in and around schools and other areas of education (see "Partnering with local schools" section in Shipchandler et al.).
Costs/funding options: Clean School Bus USA
Benefits: Comprehensive approach implementing campaign at both government and local levels.
Challenges: Not very difficult once municipalities and organizations realized the economic benefit to reducing idling.
Resources: Shipchandler et al. 2008 (attached)

Policy: AirBeat
Description: AirBeat is not so much a policy but rather a community-based project to monitor air quality and to make such information easily available to the public.
Costs/funding opportunities: N/A
Benefits: Create lasting relationships between community partners. Excellent public awareness campaign by making air quality data and locations of idling "hot spots" available to the community.
Challenges: Bridging gaps between otherwise unconnected stakeholders in all parts of community (for example businesses, low income community members, students, and truckers).
Resources: Loh et al. (2002) From Asthma to AirBeat: Community-driven monitoring of fine particles and black carbon in Roxbury, Massachusetts (attached)

Funding Options

Many opportunities for funding of idling reduction strategies exist at both the governmental and NGO level. What follows is a review of the various organizations that provide either direct funding or searchable databases of funding opportunities as well as both general and specific examples of idling reduction policies. This list is by no means complete and should remain malleable as further research and development is conducted on this campaign.

Grants.gov: www.grants.gov

Specifically, Investing in Innovation Fund:
http://www.grants.gov/search/search.do;jsessionid=GxScL93HmSvb3k6vTYMFTJ21n8Jg7hv2QKhLJJkPP3nfBknngxVs!1585175360?oppId=52789&mode=VIEW

The Investing in Innovation Fund has the primary purpose of coupling research with school improvement to benefit both community and students. This seems like a particularly applicable grant which could be applied to researching either the effects of idling or implementing an idling reduction campaign.

US Environmental Protection Agency (EPA): www.epa.gov

EPA grants and funding information: http://www.epa.gov/ogd/grants/information.htm

- Environmental Education – Interactive searchable US map. Provides grants awarded in the past for specific geographic locations (such as North Carolina).
- Community Action for a Renewed Environment (CARE) – Grants to help communities reduce pollutant exposure. Obvious application to Cumberland County Schools with purpose of reducing exposure of students to harmful idling emissions.

Clean School Bus USA: http://www.epa.gov/cleanschoolbus/funding.htm

- Directs to EPA and other organizations providing grants specific to air quality and schools.
- http://www.epa.gov/otaq/schoolbus/funding-archive.htm
    - Clean School Bus grant and funding archive with results up to 2008.

Mobile Source Emission Reduction Grant (NCDENR Div. of Air Quality) (not running in 2010):

http://daq.state.nc.us/motor/ms_grants/
http://daq.state.nc.us/news/brochures/MobileSourceGrant.pdf

- Information about applying for the grant.

Although the grant is not being made available in 2010 (most likely due to state budget cuts), it is included in case it will be provided again. In addition, the information regarding the grant application process is useful in the context of other grants.

The Environmental Education Fund (NC): http://www.eefund.org/index.php

EEF's Comprehensive Environmental Education Campaign seeks to support endeavors to promote and facilitate environmental understanding and awareness in North Carolina. The EEF partners with other organizations around the state in many programs designed with the ultimate goal of promoting environmental protection. Possible access to funding opportunities through partnership with EEF.

Eat Smart, Move More NC: http://www.eatsmartmovemorenc.com/Funding/Funding.html

Loosely affiliated with idling reduction strategies in Cumberland County Schools. Eat Smart, Move More NC works through local health departments in an attempt to improve the health of communities by promoting healthier eating habits and increasing physical activity. There is an opportunity for helpful resources if anti-idling campaign was framed as improving the overall health of students. Also, improving the air quality of schools could induce more physical activity around the school.

North Carolina Office of Environmental Education Grants Page:
http://web.eenorthcarolina.org/core/item/topic.aspx?s=0.0.108.37430&tid=85010

Provides list of grant and funding opportunities with a blurb for each. Funding opportunities are sorted by date at which grant proposals are due.

NC Air Awareness Program (Fayetteville branch): http://daq.state.nc.us/Ozone/airaware/

Link provides searchable map of North Carolina with specific emphasis placed on the Fayetteville area (contact Mark Nottingham). Unsure about funding opportunities through NC Air Awareness Program however should provide valuable resource for finding funding opportunities, other campaign resources, and connections with other organizations involved with air quality improvement in Fayetteville area.

Education and School Grants: http://www.fundsnetservices.com/educ01.htm

Provides reference list to various grant providing organizations with specific areas of funding interest.

Conclusion & Next Steps

Conclusion

This toolkit was created in order to respond to the social, environmental, and economic impacts of idling near public schools. Idling is specifically detrimental near schools because of the high concentration of private vehicles and buses, as well as the higher susceptibility of children to air pollution. Thus, this capstone sought to create a collection of materials that will enable schools to mount an Anti-Idling Campaign at specific schools throughout Cumberland County.

The toolkit includes a variety of methods and materials, which will enable different entities to mount effective and flexible campaigns that best suit the specific needs of their school. These materials were created specifically for Sustainable Sandhills and Cumberland County Schools, but would be useful to other non-profit organizations and school districts.

Next Steps

This toolkit is only the first step in the Anti-Idling School Campaign. There are several important next steps that must be taken to ensure the reduction of private vehicle idling on school grounds in Cumberland County.

The following are suggestions for the implementation of the Anti-Idling Toolkit:

1. Launch a program in pilot schools in Cumberland County.
2. Gather observational research and feedback on effectiveness of toolkit materials. Specifically:
    a. Curriculum feedback from teachers.
    b. Public awareness campaign feedback from public.
3. Present policy recommendations to administrators.
4. Engage schools with the website and encourage them to take full advantage of the materials that have been produced.

Potential Future Uses of the Toolkit

Here is a list of potential future steps that can be taken to increase the scope of the Anti-Idling Toolkit:

1. Incorporate anti-idling information/activities into Earth Day and Air Awareness Week events.
2. Engage environmental clubs on campus/student groups (such as student council).
3. Use poster winners from Air Awareness Week as campaign materials.
4. Engage sports teams/the athletic department in order to increase support of program.
5. Bring anti-idling campaign materials to the larger community through festivals and fairs.

6. Have individuals from Sustainable Sandhills go into classroom and talk about Idling/Air Quality or each a portion of the curriculum.

Potential Work for Future Capstone

Here are ideas for what a future capstone group or student intern could work on:

1. Create more campaign materials that are specifically targeted to different schools.
2. Work with community members in order to understand what prompts would be most effective specifically in Cumberland County.
3. Create presentations that could be brought to various classrooms/school events
4. Work directly with student groups/faculty members in order to integrate Anti-Idling Toolkit into their groups' work.
5. Create comprehensive policy documents for specific policies that schools are interested in enacting.

Work toward actually enacting a private vehicle no-idling policy in schools.