

# Calculation of Impact of Midtown Burner vs. “24 Additional Cars in the Phillips Neighborhood”

## I. Introduction, and summary of conclusions:

Opponents of the Midtown Burner have heard it expressed that we're making a big deal out of nothing – that the emissions from the proposed Midtown Burner are equivalent to adding 24 cars to the neighborhood. We've also heard it expressed that it would be the same as a minivan running continuously. Both are roughly the same - 24 cars driven for an average of an hour a day, vs. one car driven 24 hours every day of the year.

We tend to hear this from people who have had private conversations with the developers.

***The essential fallacy is the confusion between the total mass of emissions (products of combustion) produced by the cars, being equated to the mass of HAZARDOUS emissions produced by the Midtown Burner.***

We have seen from the MPCA application that the permitted emissions from the burner will be over one million pounds per year, consisting of carbon monoxide, volatile organics, nitrous oxides, sulfur compounds, particulates, and a variety of very dangerous pollutants in much smaller quantities: lead, arsenic, mercury, etc.

Below are calculations of the TOTAL emissions from 24 cars: for each gallon of gasoline burned, the weight of the exhaust created is approx. 99 pounds. [A gallon of gas weighs about 6.3 pounds, the air fuel mixture is 14.7 : 1, that is 14.7 pounds of air for each pound of gas, so the total weight of the exhaust is  $6.3 + (14.7 \times 6.3) = 99$  pounds per gallon of gas burned.]

Using figures from the Federal Highway Administration and the EPA, the average car is driven 12,375 miles per year, and the CAFE (required corporate average fuel economy) is 27.5 mpg (same since 1984!). So that is 10,800 gallons of gasoline consumed ( $24 \times 12,375 / 27.5$ ). The total weight of the emissions is  $99 \times 10,800 = 1,070,000$  pounds.

That is remarkably similar to the 1,082,200 pounds of potential emissions per year in the Kandiyohi application to the MPCA. Clearly, someone at Kandiyohi did just this calculation!!

But what is in that million+ pounds of exhaust coming out the tailpipes of those 24 cars? Roughly 72% of it (770,000 pounds) is pure nitrogen, drawn in from our atmosphere, then blown out the tailpipe unchanged. Nearly all the rest of it is the product of complete combustion of the hydrocarbons in gasoline: carbon dioxide (roughly 20% - 210,000 pounds), and water vapor (roughly 8%). Not so scary! The emissions of nitrogen, carbon dioxide and water are not even mentioned in the MPCA application, of course, because they are not pollutants.

Carbon dioxide, while not harmful to breathe, and naturally occurring in our air, is also, of course, a greenhouse gas. The total carbon dioxide emissions from the Midtown Burner will be equivalent to that produced by over 150,000 cars!

Of course, cars also create dangerous pollutants, but the amount is less than 1/2% of their emissions. Cars create carbon monoxide, unburned hydrocarbons, and nitrous oxides. Any other hazardous emissions are trace amounts, too small to be worth regulating. The burner will create all of these three ("volatile organic compounds" are similar to the unburned hydrocarbons from cars).

Consider a car that meets emission standards in place from 1996 through 2006 (standards have finally been tightened for brand new cars, and many of the new cars are dramatically cleaner than just a few years ago). The allowed output of carbon monoxide is 92.8 pounds per year - for the average 12,375 miles driven. The burner is allowed to emit 316,400 pounds per year - equal to 3,400 cars! The allowed output of hydrocarbons is 6.82 pounds per year. The burner is allowed to emit 53,400 pounds of volatile organic compounds - equal to 7,800 cars! And nitrous oxides - very dangerous emissions that lead to smog: a car may create 10.9 pounds per year. The burner is allowed to emit 318,400 pounds per year - equal to 29,000 cars!!!

**But it is really MUCH worse than that! Comparing the burner to cars is inherently deceptive and inaccurate. Remember that the burner creates much more than just the three pollutants that gas engine cars create. (Car emissions are "simpler" because cars burn a highly refined liquid with carefully controlled composition.)**

Though diesel engines create particulate emissions, gas engines in cars create almost none. The burner is allowed to emit over 200,000 pounds of particulate matter. This particulate matter is particularly harmful to our lungs, and will have especially serious effects on the most vulnerable among us, including the already high proportion of children in Phillips with asthma. The burner will also emit over 80,000 pounds of sulfur compounds - the stinky (and dangerous) stuff. Cars create almost none of that either, and diesel trucks create far less than they did even a few years ago because of new restrictions on sulfur in diesel fuel.

**The burner will also put out lead, benzene, chlorine, hydrochloric acid, formaldehyde, manganese, styrene, toluene, arsenic, cadmium and mercury. Is it any wonder that we don't want this in our neighborhood??**

**So, the comparison of the Midtown Burner to 24 cars is outrageously inaccurate and deceptive. I would argue that it is either deliberately deceptive, OR, Kandiyohi Development Partners is far too incompetent to design, build, and operate a wood-burning plant.**

## **II. Emissions from the Midtown Burner:**

What emissions can we expect from the Midtown Burner if it is allowed to operate?

Potential emissions are found in the Air Permit Conforming Application filed with the MPCA by Midtown Eco Energy on July 13, 2007. The values below are from the Table on page A-17. These are identified as “potential emissions”. They appear to represent the maximum expected (and permitted by the MPCA) emissions at full capacity. Actual emissions may be less. In particular, it is unlikely that all of the pollutants would be emitted at the maximum amount, so the total would almost surely be less than what is indicated below as the total weight of pollutants.

On the other hand, facilities can, and sometimes do, exceed their permitted limits. It is difficult to even know if a facility is operating within the limits. Some of these pollutants are very difficult to monitor accurately.

Criteria Pollutants:	<u>Weight in pounds</u>
CO (carbon monoxide)	316,400
VOC (volatile organic compounds)	53,400
NOx (nitrous oxides)	318,400
SOx (sulfur oxides)	79,000
PM (particulates > 10 micron)	71,800
PM10 (particulates < 10 micron)	130,800
Total other HAPs	111,200
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Total weight of pollutants	<b>1,082,200 pounds / year</b>

HAPs (Hazardous Air Pollutants) – included above

Lead	150
Benzene	13,200
Chlorine	2,400
Formaldehyde	13,800
HCl (hydrochloric acid)	60,600
Manganese	4,800
Styrene	5,800
Toluene	2,800
Arsenic	70
Cadmium	13
Mercury	5
Others (another 36 listed)	7,562
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Total	111,200 pounds / year

***Note that all data above is only for pollutants emitted by the Midtown Burner.*** Like any other facility that burns hydrocarbons, the major emissions are the products of complete combustion: H<sub>2</sub>O (water), CO<sub>2</sub> (carbon dioxide), and nitrogen (the other main component of our atmosphere, which comes out the smokestack unchanged). What we consider pollutants are only a small fraction of the matter which emerges from the smokestack. (For more about this, see section III)

The Midtown Burner is expected to burn 598,000,000 pounds of wood per year (Application, page C-2). Assuming an air-fuel ratio roughly equal to that for burning gasoline (14.7 pounds of air for each pound of fuel), the total weight of emissions coming out of their smokestack will be over 9,000,000,000 pounds per year (9 billion).

Carbon dioxide (not a pollutant, but important as a greenhouse gas) is at least 15% of that (I don't have good figures for the ratio of CO<sub>2</sub> to H<sub>2</sub>O for wood burning). That means at least 1,300,000,000 pounds (675,000 tons) of carbon dioxide per year. Much of that is offset by CO<sub>2</sub> absorbed by the wood during its growth. But, when burning old trees, CO<sub>2</sub> is released in one year that was absorbed during as much as 100 years of growth. Also, based on the Expected Operation Schedule on page C-2 of the Application, over 12% of the energy produced will come from the natural gas ignitors. That also has an impact on the carbon-neutrality of the Burner. Any shortage of wood would result in even greater consumption of natural gas.

### **III. Total emissions from passenger cars:**

What are the total tailpipe emissions for 24 cars?

Calculations are based on the following data:

Average miles driven per year: 12,375 miles (from Federal Highway Administration figures for 2005 (most recent available), found at <http://www.fhwa.dot.gov/policy/ohim/hs05/htm/vm1.htm>)

Average fuel economy: 27.5 mpg (based on the federally required Corporate Average Fuel Economy (CAFE) standard in effect since 1984. That is a minimum requirement, actual average fuel economy of new cars is slightly better. Newer cars suffer very little change in fuel economy as they age. However, many factors, including driving habits, trip distance, cold weather, and poorly maintained vehicles, have an impact, so 27.5 mpg is somewhat optimistic.)

Weight of a gallon of gasoline: approximately 6.3 pounds (from <http://www.fueleconomy.gov/feg/co2.shtml> Actual weight varies depending on varying blends.)

Composition of air, by weight: 76.7% Nitrogen, 23.2% Oxygen, neglecting roughly 1% of other gases.

Air fuel ratio: 14.7 pounds of air to 1 pound of gasoline (stoichiometric ratio)

Carbon dioxide produced by burning a gallon of gas: 19.4 pounds (from the EPA's Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle, at <http://www.epa.gov/otaq/climate/420f05004.htm>)

Input to the car's engine, per gallon of gasoline:

Gasoline (C <sub>x</sub> H <sub>x</sub> )	6.3 pounds
Oxygen	21.6 pounds (23.2% x 6.3 x 14.7)
Nitrogen	71.0 pounds (76.7% x 6.3 x 14.7)
Total weight	<hr/> 98.9 pounds

Output (total emissions from the tailpipe), per gallon of gasoline:

Knowing that the nitrogen passes through unchanged, and that carbon dioxide produced is 19.4 gallons per gallon of gasoline burned, and based on conservation of mass, the outputs are:

CO <sub>2</sub> (carbon dioxide)	19.4 pounds (19.6%)
H <sub>2</sub> O (water vapor)	8.5 pounds ( 8.6%)
Nitrogen	71.0 pounds (71.8%)
Total out the tailpipe	<hr/> 98.9 pounds per gallon of gasoline burned

Gallons of gasoline per year for average car = 12,375 miles / 27.5 mpg = 450 gallons

Total emissions per car per year = 450 x 98.9 = 44,500 pounds per year

Total annual emissions for 24 cars = 24 x 44,500 = **1,068,000 pounds per year**

**Note how remarkably close this is to the 1,082,200 pounds per year of POLLUTANTS from the Midtown Burner!**

Clearly, someone associated with Midtown Eco Energy also did this calculation to come up with their comparison. They didn't just guess at the number 24, they clearly based it upon a similar calculation.

**The essential fallacy in the comparison is the confusion between the total mass of emissions (products of combustion) produced by the cars, being equated to the mass of HAZARDOUS emissions produced by the Midtown Burner.**

The numbers are very similar, but their meaning and importance are vastly different. It is comparing apples and oranges. Who really cares about how much water vapor and nitrogen come out the tailpipes of our cars? Yes, cars also emit pollutants from their tailpipes, but in MUCH smaller quantities, as shown in section IV.

Whoever originated the comparison to 24 cars almost surely based it upon calculations similar to those above. That means they intended to deceive. Anyone capable of performing or understanding those calculations surely is aware of the difference between pollutants and total emissions. Other people, probably including people associated with Midtown Eco Energy, passed along that comparison innocently and naively, though it really goes against common sense. How could the pollution from 24 cars possibly equal the pollution from burning nearly 600 million pounds of wood?

### **Greenhouse gases:**

The carbon dioxide produced by cars, while not a pollutant in the sense of causing health hazards, is of concern due to its effects on climate change. The average car, based on the figures above, creates  $450 \times 19.4 = 8730$  pounds of CO<sub>2</sub> per year. Thus, the Midtown Burner's output of CO<sub>2</sub> is very roughly equivalent to  $1,300,000,000 / 8730 = 150,000$  cars!

This comparison is not fair. Even if the carbon-neutrality of the burner is suspect, its CO<sub>2</sub> emissions are offset to a considerable degree by the absorption

of carbon by trees during their lifetime. In addition, given a certain demand for power, any combustion process will generate similar amounts of CO<sub>2</sub>. The greenhouse gas effects of wood burning are better than the burning of fossil fuels – though not as good as wind, solar, geothermal, or hydroelectric power, or, better yet, energy conservation.

The effects of CO<sub>2</sub> reduction are felt on a **global scale**, not a local neighborhood scale. CO<sub>2</sub> does not cause health problems in the immediate area where it is generated. So on a global scale, the reduced greenhouse gas effect of the Midtown Burner would be an improvement over burning coal or natural gas. But locally, in the Phillips Neighborhood, this benefit is vastly outweighed by the immediate and local effects of particulates and other pollutants on the residents' health.

#### **IV. Pollution from Passenger Cars:**

Now let's try to compare apples to apples: how do the pollutants generated by cars compare with the pollutants that would be generated by the Midtown Burner?

Gasoline engine cars emit three significant pollutants, regulated by the EPA: CO (carbon monoxide), HC (unburned hydrocarbons), and NO<sub>x</sub> (nitrous oxides). All other pollutants are relatively insignificant.

Calculations based on:

Average miles driven per year: 12,375 (same as above)

Maximum emissions as set by the EPA under the Clean Air Act:

CO: 3.4 grams / mile

HC .25 grams / mile

Nox: .4 grams / mile

These standards have been in place since 1996. All cars since then have been designed and tested not to exceed these limits when new. Of course, actual emissions are less than or equal to these amounts. New cars in the last few years are even cleaner, due to tighter standards and incentives to build "ultra-low emissions" vehicles.



Assume no degradation in emissions performance with age. We assume here that the 24 additional cars in the comparison are fairly new cars, and that they are properly maintained. Newer vehicles actually suffer little degradation in emissions performance. In all cars since 1996, any malfunction which significantly affects emissions will trigger the “check engine” light. Back when emissions testing was in effect in the Twin Cities, even many older cars were way under the allowable emissions standards.

Carbon monoxide emissions:  $3.4 \text{ grams/mile} \times 12,375 \text{ miles} / 453.6 \text{ grams/pound} = 92.8 \text{ pounds/year}$

Burner emissions of carbon monoxide = 316,400 pounds/year – roughly equivalent to -  $316400 / 92.8 = \mathbf{3,400 \text{ cars!}}$

Hydrocarbon emissions:  $.25 \times 12,375 / 453.6 = 6.82 \text{ pounds/year}$

Burner emissions of volatile organic compounds (similar to hydrocarbons) = 53,400 pounds/year - roughly equal to  $53,400 / 6.82 = \mathbf{7,800 \text{ cars!}}$

Nitrous oxide emissions:  $.4 \times 12,375 / 453.6 = 10.9 \text{ pounds/year}$

Burner emissions of nitrous oxides = 318,400 pounds/year – roughly equivalent to -  $318,400 / 10.9 = \mathbf{29,000 \text{ cars!!}}$

If we total all three emissions, a car emits 110.5 pounds/year; the burner emits 688,200 pounds/year.

The burner would be equivalent to roughly  $688,200 / 110.5 = \mathbf{6,200 \text{ cars!}}$

But cars don't all belch their pollution from one stationary source, 24 hours every day. And any cars added to the neighborhood wouldn't do all their driving in the area most impacted by the burner. Let's look at it another way:

Those 6200 cars represent an annual miles driven =  $6200 \times 12,375 = 77,000,000$  miles/year. Let's compare the effect within a 3 mile radius of the burner – a six mile trip through Phillips and the surrounding neighborhoods. How many trips through the neighborhood does that represent?  
 $77,000,000 / 6 = 12,800,000$  trips, or **35,000 additional trips through the neighborhood every day of the year!**

**ANY comparison between cars and the Midtown Burner is inherently wrong and misleading!**

The above analysis considers only three pollutants. The Midtown Burner would emit large amounts of damaging pollutants that no amount of additional car traffic could create. Gasoline is a highly refined liquid fuel with carefully controlled composition. Wood is much more variable, and full of a wide variety of contaminants, from dirt to heavy metals. As a solid, it is harder to burn completely. Thus the pollutants from a car engine are much simpler.

**Particulate pollution is particularly dangerous to health**, especially to those, like too many of our children, who already suffer from asthma. Gasoline engine cars emit very little particulates. Diesels in trucks and buses emit particulates, but they are getting cleaner all the time.

Gas engines also emit very little sulfur dioxide. Diesels emit much more, but this has been cleaned up dramatically in recent years with low-sulfur fuels.

And all those other HAPs, listed in section II.? Cars emit trace amounts of benzene and formaldehyde, but virtually none of the rest. We don't want additional lead, mercury, and arsenic in our neighborhood!

--- Dave Bicking  
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Anyone wishing further documentation or clarification is invited to contact NAB through our "Contact" page on this website.