



FIRST OF SERIES

GLOBAL WARMING/CLIMATE CHANGE/PREMATURE DEATHS TO BE REDUCTED BY MORE THAN 20% BY TECHNOLOGY AVAILABLE NOW

By Frankie Fruge, President, Cyclone Power Technologies Inc.

NOx AND HEAT IN ENGINE EXHAUST NEGATIVELY IMPACTS - GLOBAL WARMING/CLIMATE CHANGE, PLANTS, ANIMALS, AND HUMANS - THE ANSWER IS HERE NOW. CYCLONE POWER ENGINES NEAR-ZERO NOx - 66% DECREASE OF HEAT & PARTICULATES

Nitrogen and oxygen are present in the ambient air, which means they're present in the air-fuel mixture combusted in all gasoline and diesel engines. During high temperature/high pressure combustion, these elements combine to form nitrogen oxides (NOx). Concentrations of NOx in untreated diesel exhaust are typically between 50 and 1000 parts per million (ppm) but can be many times higher.^[1] It is not possible to design an internal combustion engine that does not produce NOx when it burns fuel.^[2] BUT CYCLONE HAS DESIGNED A LOW TEMPERATURE EXTERNAL COMBUSTION ENGINE THAT BRINGS NOx LEVELS TO NEAR-ZERO OR ZERO.^[3]

NOx reacts with atmospheric chemicals to form secondary fine particulate matter (PM_{2.5}), or soot. Exposure to PM_{2.5} can cause stroke, ischemic heart disease, chronic obstructive pulmonary disease, lung cancer, and lower respiratory infections.^[4] PM_{2.5} caused 30,000 deaths and lower life expectancy in 2015 in the US alone^[5].

When combined with volatile organic compounds and sunlight, NOx contributes to the formation of ground-level ozone, a major component of smog. According to the US EPA, even relatively low levels of ground level ozone can cause health effects, or exacerbate chronic lung diseases like asthma, chronic obstructive pulmonary disease, or emphysema, especially among vulnerable populations like children and the elderly, for whom it may prove deadly.^[6]

Let us put the global diesel air pollution human health problem in perspective. According to estimates published by the World Health Organization, 7 million people died as a result of air pollution exposure in 2012 (WHO, 2014).^[7] Together, PM_{2.5} and ozone concentrations from transportation emissions resulted in 7.8 million years of life lost and approximately \$1 trillion (2015 US\$) in health damages globally in 2015.^[8]

NOx emissions also affect ecosystems and agricultural crops. Ozone pollution is toxic to plants and contributes to loss of biomass, crop yields, and forest productivity. PM_{2.5}



pollution reduces solar irradiation, decreasing photosynthesis in plants and reducing their biomass. The loss in biomass means less carbon is sequestered in plants, leaving more CO₂ in the atmosphere. Both ozone and PM_{2.5} pollution can directly change the way ecosystems work by affecting the exchange of CO₂ and water vapor across the surface of leaves, which can have significant effects on hydrology—even changing stream flows.

Particulate matter or soot is created during the incomplete combustion of diesel fuel. Its composition often includes hundreds of chemical elements, including sulfates, ammonium, nitrates, elemental carbon, condensed organic compounds, and even carcinogenic compounds and heavy metals such as arsenic, selenium, cadmium and zinc.^[9] Though just a fraction of the width of a human hair, particulate matter varies in size from coarse particulates (less than 10 microns in diameter) to fine particulates (less than 2.5 microns) to ultrafine particulates (less than 0.1 microns). Ultrafine particulates, which are small enough to penetrate the cells of the lungs, make up 80-95% of diesel soot pollution.^[10]

In 2012, the World Health Organization (WHO), concluded that diesel engine exhaust is carcinogenic to humans.^[5] Exposure to high levels of diesel exhaust has been shown to cause lung tumors in rats, and studies of humans routinely exposed to diesel fumes indicate a greater risk of lung cancer. For example, occupational health studies of railroad, dock, trucking, and bus garage workers exposed to high levels of diesel exhaust over many years consistently demonstrate a 20 to 50 percent increase in the risk of lung cancer or mortality.^[11]

Of course, soot levels in many cities of China, India and poorer countries are much worse than in the US and Europe, with horrible health impact. Dirty diesel trucks, backup generators, dirty motorbikes, rickshaws, and cars with little to no pollution control devices (as well as coal plants) are to blame.

NOx in Gasoline powered engines:

In the US, Europe and Japan, modern gasoline-engine vehicles are equipped with an effective three-way catalytic converter as part of the exhaust system. It's called a three-way catalytic converter because it controls three pollutants: carbon monoxide (CO), which combines with oxygen in the converter to become carbon dioxide (CO₂); unburned hydrocarbons, which combine with oxygen to produce CO₂ and water vapor (H₂O); and NOx, which is reduced over the catalyst to nitrogen and water and/or CO₂. The three-way catalyst, invented in the 1970s, is inexpensive and poses little or no penalty to fuel economy, performance, drivability, or maintenance. And it is effective. A new 2017 gasoline-engine passenger car properly tuned and with a well-maintained catalyst operating in normal conditions, reduces by 90% the NOx that would otherwise exit the tailpipe. (This does not mean that the NOx problem is fully solved for gasoline



engines; a hundred thousand cars stuck in traffic still add up to a health hazard and a pollution problem.)^[12]

NOW FOR BOTH GASOLINE AND DIESEL ENGINES THERE IS STILL SIGNIFICANT NOx AND ALSO HEAT WHICH EXISTS THE ENGINE AT 1200⁰F in gasoline and 700 to 1090⁰F in diesel engines.

Fact: There are 276 million registered motor vehicles in the US in 2019 and over 1.2 Billion worldwide, inclusive of gas and diesel. If the average exhaust temperature is 1000⁰F, that means we are putting 276 million times 1000⁰F of additional exhaust heat into the atmosphere every second we run these engines. And this is just on road vehicles in the US, not even considering the more than one billion registered vehicles outside the US, or the heat and NOx coming from off road, generators, pumps, train, ships, etc. that are all putting NOx and excessive heat into our world.^{[13][14]}

NOW FOR THE SOLUTION TO EXCESSIVE HEAT AND NOx.

External combustion engines are here NOW with NEAR-ZERO to ZERO NOx; exhaust heat to the atmosphere of only 190⁰F to 350⁰F; no catalytic converter needed; and able to use Gasoline or Diesel or Biofuel or any combustion with the same results. Efficiencies of energy used to energy out is between 32% and 37% depending on working fluid temperature. ZERO oil changes and manufacturing friendly.^[3]

HEAT TO ATMOSPHERE IS NOW REDUCED BY 276 MILLION(USA)/1.2 BILLION (WORLD) TIMES 275⁰F (CYCLONE AVERAGE EXHAUST TEMPERATURE) A REDUCTION OF 66%.

CYCLONE POWER ENGINES, HEAT REGENERATIVE EXTERNAL COMBUSTION, RANKINE CYCLE IN SIZES FROM LAWN MOWERS TO 1 MW POWER PLANTS.

NEAR-ZERO TO ZERO NOx - A REDUCTION OF 97% to 100%

Greenhouse gases and waste heat contribute to global warming:

A greenhouse gas (sometimes abbreviated GHG) is a gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases cause the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone.^[15]

Elon Musk has dubbed the internal combustion engine, powered as it is by thousands of small explosions inside its cylinders, a “remarkable kludge.” Automotive engineers have indeed made modern gasoline and diesel engines perform remarkably — but now the limits are being reached.^[16] Electric cars are only as clean as the source(s) of power



that charge their batteries and build them in the first place. In fact, it takes more than twice the amount of energy to produce an electric car as a conventional one.^[17]

Now technology trends, public insistence, industry investment, and government policy are all signaling that Beilenson's dream — an end to the burden of a transportation system powered by exploding gasoline or diesel combustion engines — is coming within grasp.^[16]

THE ANSWER

By employing the use of Cyclone's external combustion engine, we have:

- Reduced the heat to the atmosphere by 66%
- Eliminated NOx by 97% to potentially 100%, *the greatest health risk component of Greenhouse gases*
- Reduced carbon dioxide by 30% or more
- Eliminated the use of oil to lubricate the engine
- Reduced particulate matter by 80% by Cyclone's centrifuge burning
- Reduced significantly the 4.2 million premature deaths caused by ICE's

An **external combustion engine** is a **heat engine** where an **(internal) working fluid** is compressed and heated by combustion of an **external** fuel through the engine wall or a heat exchanger. The fluid then, by **expanding** and acting on the mechanism of the engine (piston or turbine), produces a shaft power.^[18]

“We have One Planet and Now One Engine to preserve it!”

If you have questions please email them to: info@cyclonepower.com

Sources:

1. [DieselNet.com, Gaseous Emissions – Nitrogen Oxides Revision 2018.01](https://www.dieselnet.com/gaseous/emissions/nitrogen_oxides/)
2. <https://www.chevron.com/-/media/chevron/operations/documents/diesel-fuel-tech-review.pdf>
3. <https://www.greencarcongress.com/2009/03/dieselfueled-cyclone-external-combustion-engine-shows-nearzero-nox.html>
4. https://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf
5. <https://www.sciencedaily.com/releases/2019/07/190723142937.htm>



6. <https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics#effects>
7. https://sustainabledevelopment.un.org/content/documents/1008357_Piqueras_The%20rapidly%20growing%20death%20toll%20attributed%20to%20air%20pollution-A%20global%20responsibility.pdf
8. <https://theicct.org/publications/health-impacts-transport-emissions-2010-2015>
9. <https://www.thoughtco.com/what-is-nitrogen-oxide-pollution-1204135>
10. <https://www.ucsusa.org/resources/diesel-engines-public-health>
11. [Health Assessment Document for Diesel Engine Exhaust. National Center for Environmental Assessment, Office of Research and Development, US EPA. Washington D.C. May 2002. page 9-11. EPA/600/8-90/057F](#)
12. <https://theicct.org/cards/stack/vehicle-nox-emissions-basics#3>
13. https://www.greencarreports.com/news/1093560_1-2-billion-vehicles-on-worlds-roads-now-2-billion-by-2035-report
14. <https://www.statista.com/statistics/859950/vehicles-in-operation-by-quarter-united-states/>
15. https://en.wikipedia.org/wiki/Greenhouse_gas
16. <http://www.greenenergytimes.org/2016/08/18/the-internal-combustion-engine-is-the-end-in-sight/>
17. <https://www.dw.com/en/how-eco-friendly-are-electric-cars/a-19441437>
18. <http://www.bioliquids-chp.eu/index.php%3Fid%3D35%26rid%3D12%26r%3D>

TOPICS FOR future Series: Why the Clean/Efficient Small External Combustion Engine Was Just Invented; and Sustainable Solar and Biomass Power Generation with the Cyclone Engine