



## FIRST OF SERIES

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

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**NO<sub>x</sub> AND HEAT IN ENGINE EXHAUST NEGATIVE IMPACTS - GLOBAL WARMING/CLIMATE CHANGE, PLANTS, ANIMALS, AND HUMANS - THE ANSWER IS HERE NOW!!** **CYCLONE POWER ENGINES NEAR-ZERO NO<sub>x</sub> - 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 NO<sub>x</sub>. It's not possible to design an internal combustion engine that does not produce NO<sub>x</sub> when it burns fuel. BUT CYCLONE HAS DESIGNED A LOW TEMPERATURE EXTERNAL COMBUSTION ENGINE THAT BRINGS THIS TO NEAR-ZERO OR ZERO NO<sub>x</sub>.

NO<sub>x</sub> production in diesel engines runs from 850mg/m<sup>3</sup> to 1250mg/m<sup>3</sup> based on peak temperature combustion:

NO<sub>x</sub> reacts with atmospheric chemicals to form secondary fine particulate matter (PM<sub>2.5</sub>), or soot. Exposure to PM<sub>2.5</sub> can cause stroke, ischemic heart disease, chronic obstructive pulmonary disease, lung cancer, and lower respiratory infections.<sup>5</sup> PM<sub>2.5</sub> caused [4.2 million premature deaths](#) worldwide in 2015.

When combined with volatile organic compounds and sunlight, NO<sub>x</sub> helps form ground-level ozone, a major component of smog. Ozone can cause 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. Researchers attribute [254,000 premature deaths](#) to ozone pollution in 2015.<sup>5</sup>

NO<sub>x</sub> 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<sub>2.5</sub> 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 CO<sub>2</sub> in the atmosphere. Both ozone and PM<sub>2.5</sub> pollution can directly change the way ecosystems work by affecting the exchange of CO<sub>2</sub> 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.<sup>1</sup> 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.

Diesel exhaust has been classified a potential human carcinogen by the U.S. Environmental Protection Agency (EPA) and the International Agency for Research on Cancer. 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.<sup>2</sup>

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 and cars with little to no pollution control devices (as well as coal plants) are to blame.

NO<sub>x</sub> 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 (CO<sub>2</sub>); unburned hydrocarbons, which combine with oxygen to produce CO<sub>2</sub> and water vapor (H<sub>2</sub>O); and NO<sub>x</sub>, which is reduced over the catalyst to nitrogen and water and/or CO<sub>2</sub>. 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 NO<sub>x</sub> that would otherwise exit the tailpipe. (This does not mean that the NO<sub>x</sub> 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.)



NOW FOR BOTH GASOLINE AND DIESEL ENGINES THERE IS STILL SIGNIFICANT NO<sub>x</sub> AND ALSO HEAT WHICH EXITS THE ENGINE AT 1200<sup>0</sup>F in gasoline and 700 to 1090<sup>0</sup>F 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, and if the average exhaust temperature is say 1000<sup>0</sup>F that means we are putting into the air 276 million times 1000<sup>0</sup>F 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 NO<sub>x</sub> coming from off road, generators, pumps, train, ships, etc. that are all putting NO<sub>x</sub> and excessive heat into our world.<sup>8</sup>

### NOW FOR THE SOLUTION TO EXCESSIVE HEAT AND NO<sub>x</sub>.

External combustion engines are here NOW with NEAR-ZERO to ZERO NO<sub>x</sub>; exhaust heat to the atmosphere of only 190<sup>0</sup>F to 350<sup>0</sup>F; no catalytic converter needed; and able to use Gasoline or Diesel or Bio-Fuel 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.<sup>1</sup>

HEAT TO ATMOSPHERE IS NOW REDUCED BY 276 MILLION(USA)/1.2 BILLION (WORLD) TIMES 275<sup>0</sup>F (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 NO<sub>x</sub> - 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.<sup>4</sup>

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.<sup>6</sup> And while there are specific uses for electric cars, it has to be noted that they use twice the amount of fuel to create the electricity for them.<sup>7</sup>



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.<sup>3</sup>

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.
- 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.<sup>3</sup>

"We have One Planet and **Now** One Engine to preserve it!"

Sources: If you have **questions** please email them to: [info@cyclonepower.com](mailto:info@cyclonepower.com)

1. <https://www.greencarcongress.com/2009/03/dieselfueled-cyclone-external-combustion-engine-shows-nearzero-nox.html>
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3. <https://www.theicct.org>
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TOPIC FOR Series Number 2: Why the Clean/Efficient Small External Combustion Engine Was Just Invented and Its Attributes over Diesel and Internal Combustion Engines