

ENHANCEMENT OF INTERNAL COMBUSTION ENGINES PERFORMANCE USING SOLAR HHO-SYSTEM

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ABSTRACT

This project recommends the use of a newly designed solar-oxyhydrogen system that will improve the general efficiency of a vehicle as well as the emissions released to the environment. Oxyhydrogen, mostly known as HHO, is a mixture of hydrogen and oxygen gases that can be produced through water electrolysis. The recommended design includes the use of flexible solar power panels placed on the roof of the vehicle that have the capability of converting photovoltaic rays from the sun into electric power. The implementation of this design will increase any vehicle efficiency and may be able to compete against hybrid vehicles. Also, the implementation of this design will reduce the emissions of hazardous elements to the environment.

OBJECTIVE

The objective of this project is to work together as a team to study the advantages of the implementation of solar-oxyhydrogen systems into vehicles, with the objective of increasing the efficiency of the car at the same time that it will reduce the pollutant emissions to the environment. The team will study the current market alternatives to conventional internal combustion engines (such as hybrid vehicles) and will focus on the system mentioned above: equipment required, method, theory behind the method and analysis of the efficiency and emissions to the environment.

ANALYSIS

Electrolysis, the most common way to produce HHO, consists on the interaction between a direct current and water, forming the desired gas. For this project, we are studying an 'on demand' system, that will produce HHO when needed, creating a lighter product. There are four steps in the process: Electrical source, HHO Production, Injection and Combustion of the mixture. Electricity will be the three GP-Flex 200 solar panels installed on the roof of the vehicle. There will be, also a rechargeable battery and a charge controller, whose duty is to charge and discharge the battery. An Ogo21 Dry Cell was picked to create the HHO through electrolysis. This cell is able to provide a 5 liter per minute flow, enough to improve the efficiency of the car since only 0.25 liter per minute of HHO is required. As soon as the HHO is injected into the combustion chamber and mix with the gas, the vehicle will follow a regular Otto Cycle like conventional vehicles do.

CONCLUSION

According to the Otto Cycle, efficiency depends on the compression ratio and the ratio of specific heats. Using a mixture of HHO and gasoline, the cycle occurs at a higher temperature, increasing the efficiency and therefore saving money for the customer. Research made by Mutah University with real tested engines proves that emissions of CO, CO₂ (for some speeds), Hydrocarbon and NO_x are dramatically reduced by adding HHO into the mixture.

With this results, it is obvious that the addition of an Solar HHO System will increase efficiency and reduce the harmful emissions of the vehicle with a low cost investment, being able to compete against traditional hybrid cars.

REFERENCES

- [1] "Electrolysis Schematic Diagram" [http://s3.amazonaws.com/img/shared/discuss_editlive/4106723/2013_01_10_13_25_07/download%20\(5\).jpg](http://s3.amazonaws.com/img/shared/discuss_editlive/4106723/2013_01_10_13_25_07/download%20(5).jpg)
- [2] Amrani Y., Martin R., Montarroyos M., Tchewa G. "Final report HHO-System" Montgomery (WV), November 2015
- [3] "Ogo 21 Plate Dry Cell" http://www.ogohho.com/omsimg/detail/20150905154913_788.jpg
- [4] "GP-FLEX 200 Specifications" <http://gpelectric.com/products/solar-flex-kits-modules>
- [5] "Emission Summary Tables" <http://3A%2F%2Fwww.uobabylon.edu.iq%2Fsustainability%2Ffiles%2FGWP.doc&usg=AFQjCNHA76HbAjgtfCWu37Dsx4robMtJbg&bvm=bv.107467506,d.dmo>
- [6] "Emission Comparison Graphs" http://www.blulabresearch.org/wp-content/uploads/2013/07/2011_Effect-of-HHO-gas-on-combustion-emissions-in-gasoline-engines_S.A.Musmar-et-al.pdf

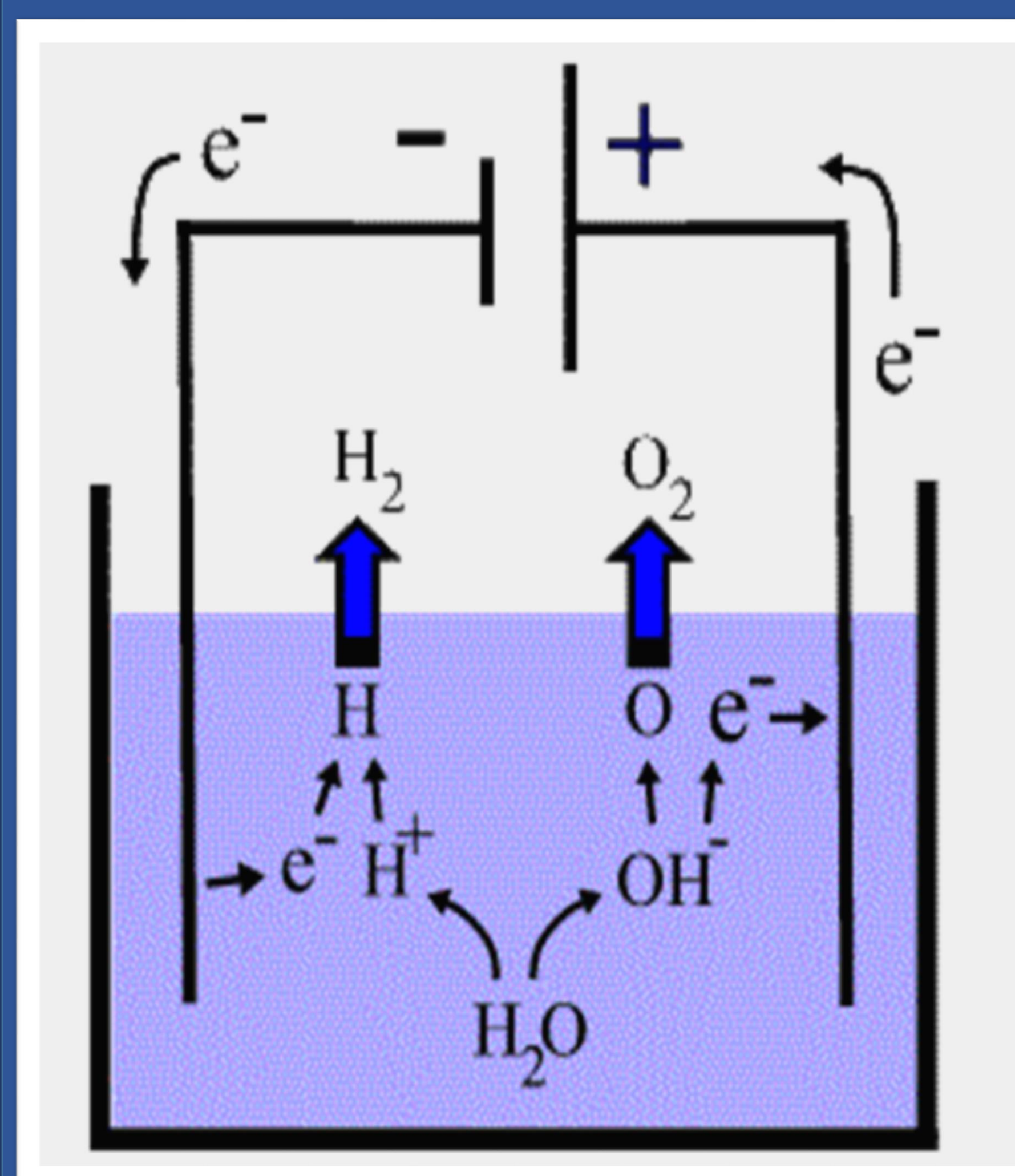


Figure 1: Electrolysis Schematic Process

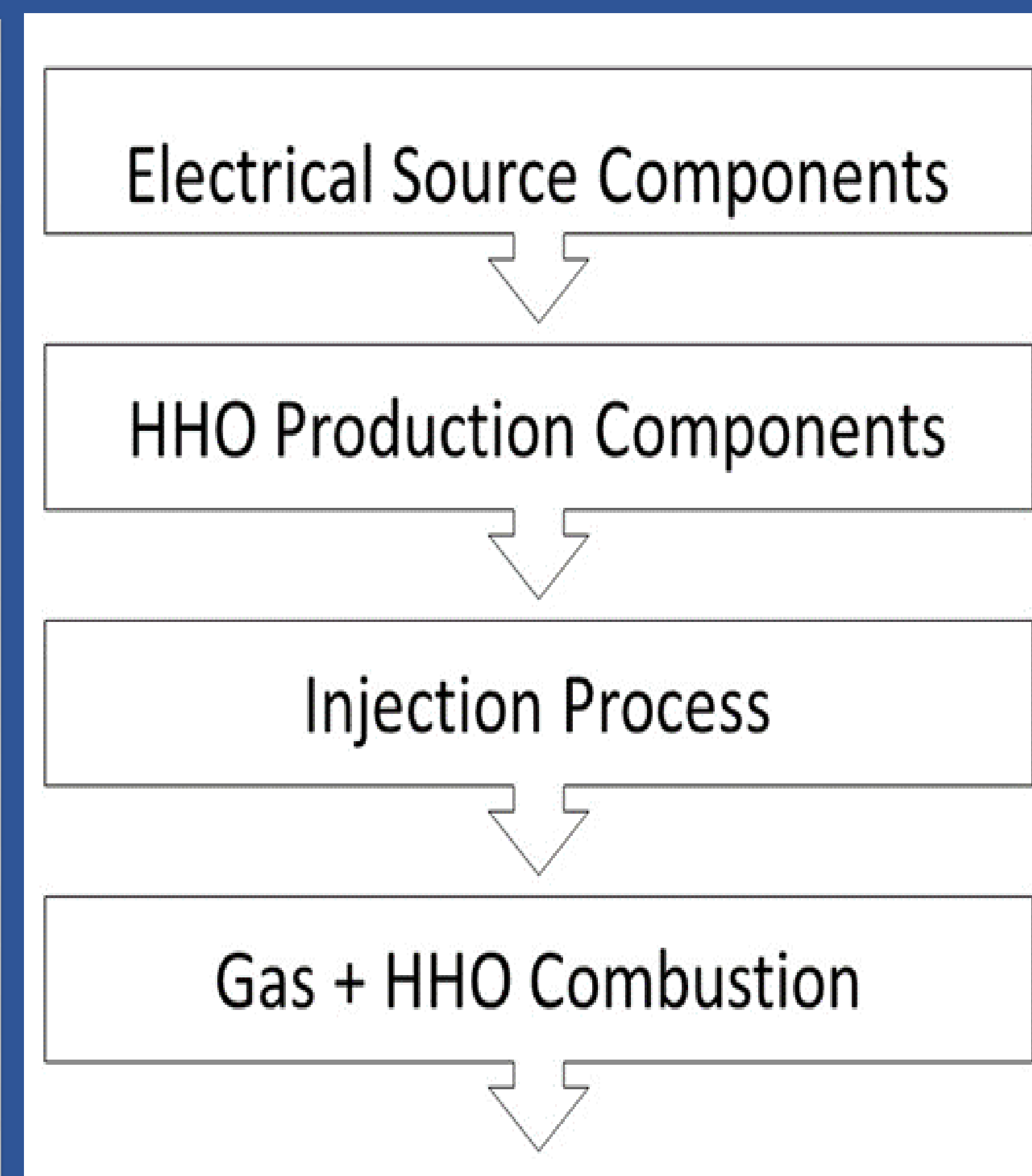


Figure 2: Solar HHO System Process

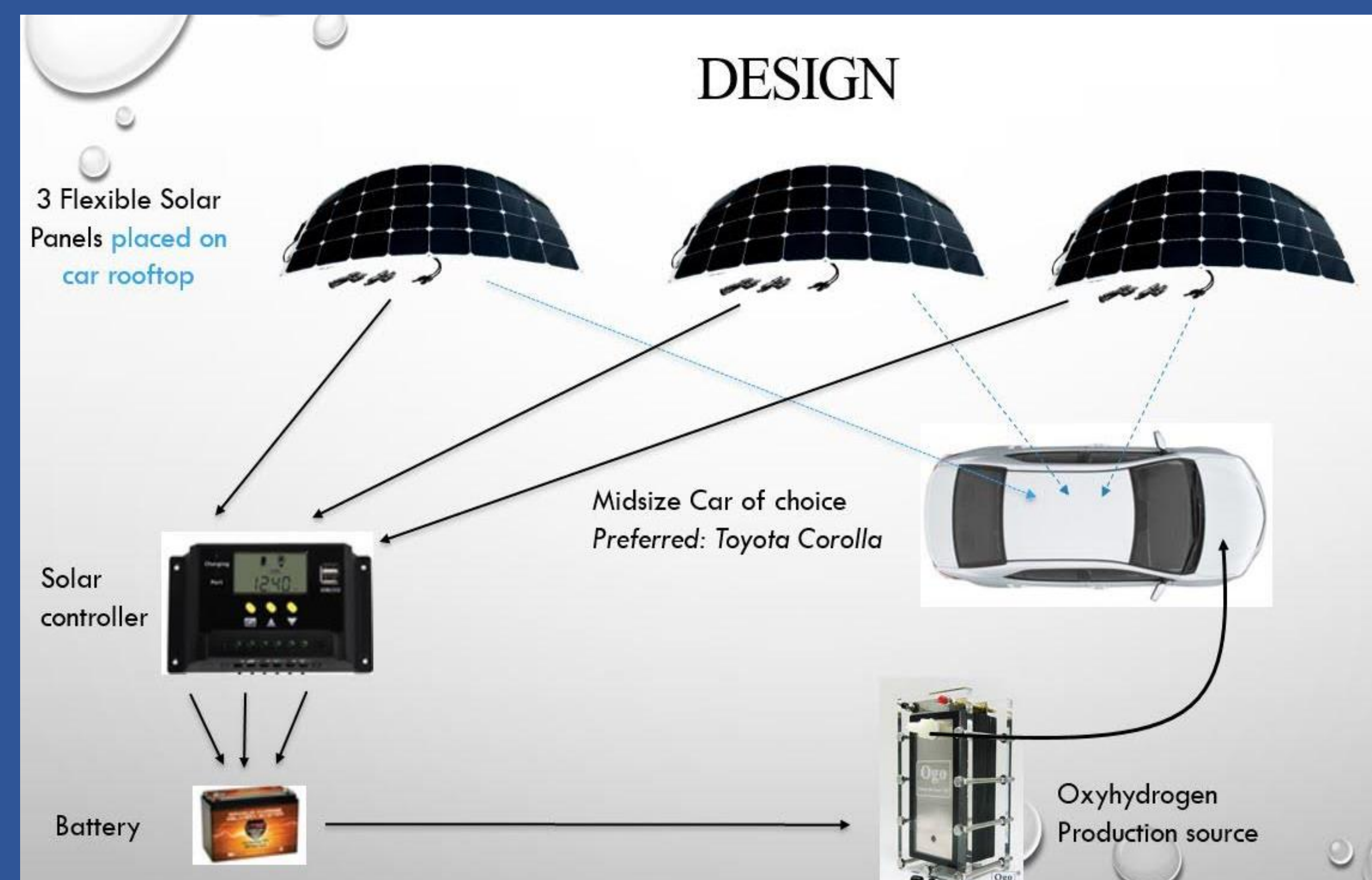


Figure 3: Schematic Proposed Solar HHO System Design

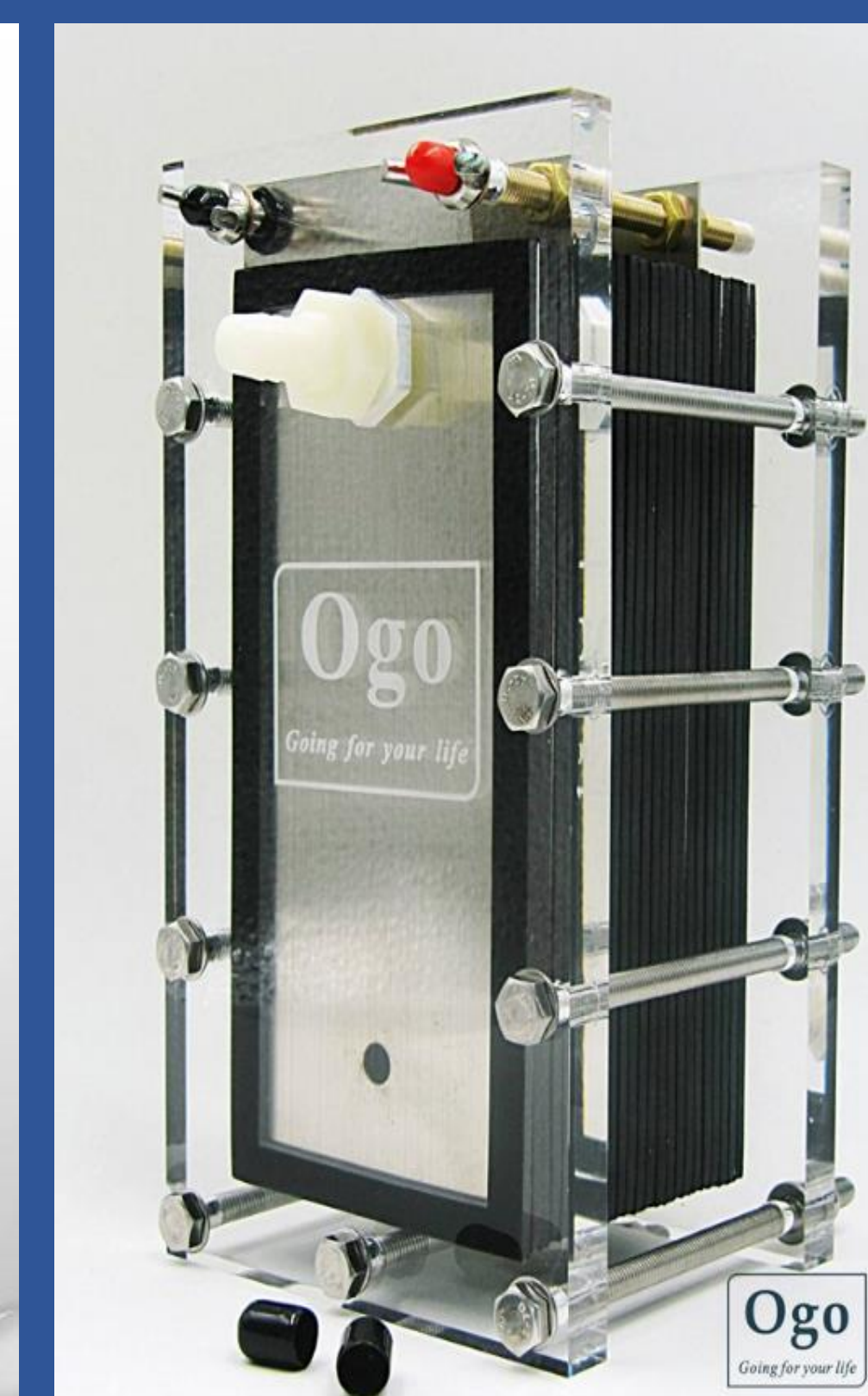


Figure 4: Ogo 21 Plate Dry Cell

Cell Type	Monocrystalline
Solar Panel Output Power	100 W
Solar Controller	30 A, PWM
Output Power warranty	10 years
Maximum power current	5.62 A
Maximum power voltage	17.8 V
Open circuit voltage (Voc)	20.8 V
Short circuit current (Isc)	6.01 A
Module Efficiency	19.99%
Maximum System Voltage	60 VDC
Maximum power tolerance	+/- 5%
Dimensions (cm)	106 x 54 x 0.3
Surface Area	5724 cm ²
Weight	1.35 kg

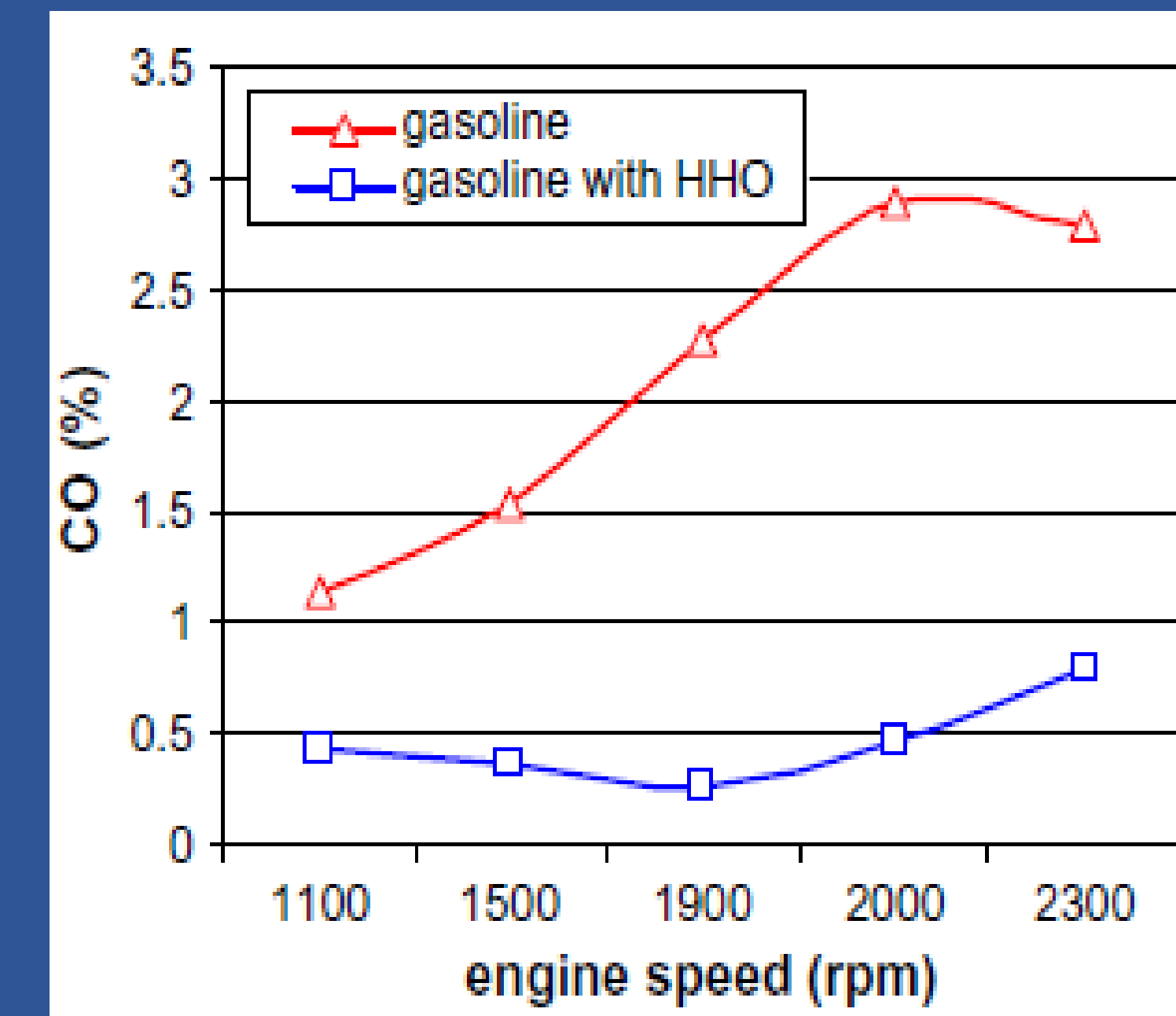
Table 1: GP-FLEX 200 Solar Panel Specifications

Exhaust Component	CO ₂	CO	NO _x	HC
Amount	5.5%	2.25%	0.0770%	0.1150%
Global Warming Potential in 100 years (GWP)	1	3	298	4
Fraction of Global Warming Potential	0.055	0.0675	0.22946	0.0046
Total Global Warming Potential	0.35656			

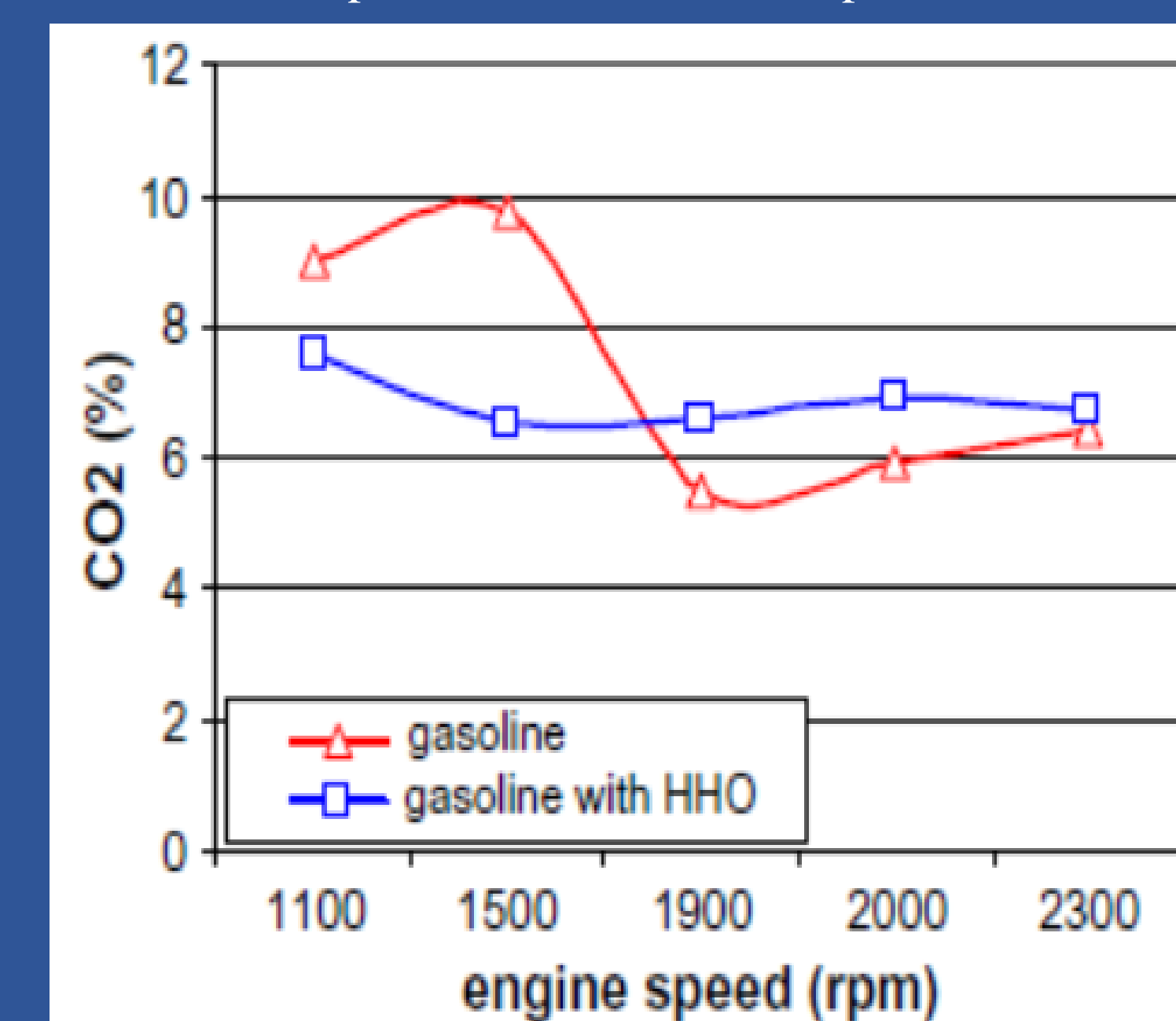
Table 2: Pure Gasoline Combustion Engines Emission Summary

Exhaust Component	CO ₂	CO	NO _x	HC
Amount	6.8%	0.3%	0.0460%	0.0900%
Global Warming Potential in 100 years (GWP)	1	3	298	4
Fraction of Global Warming Potential	0.068	0.009	0.13708	0.0036
Total Global Warming Potential	0.21768			

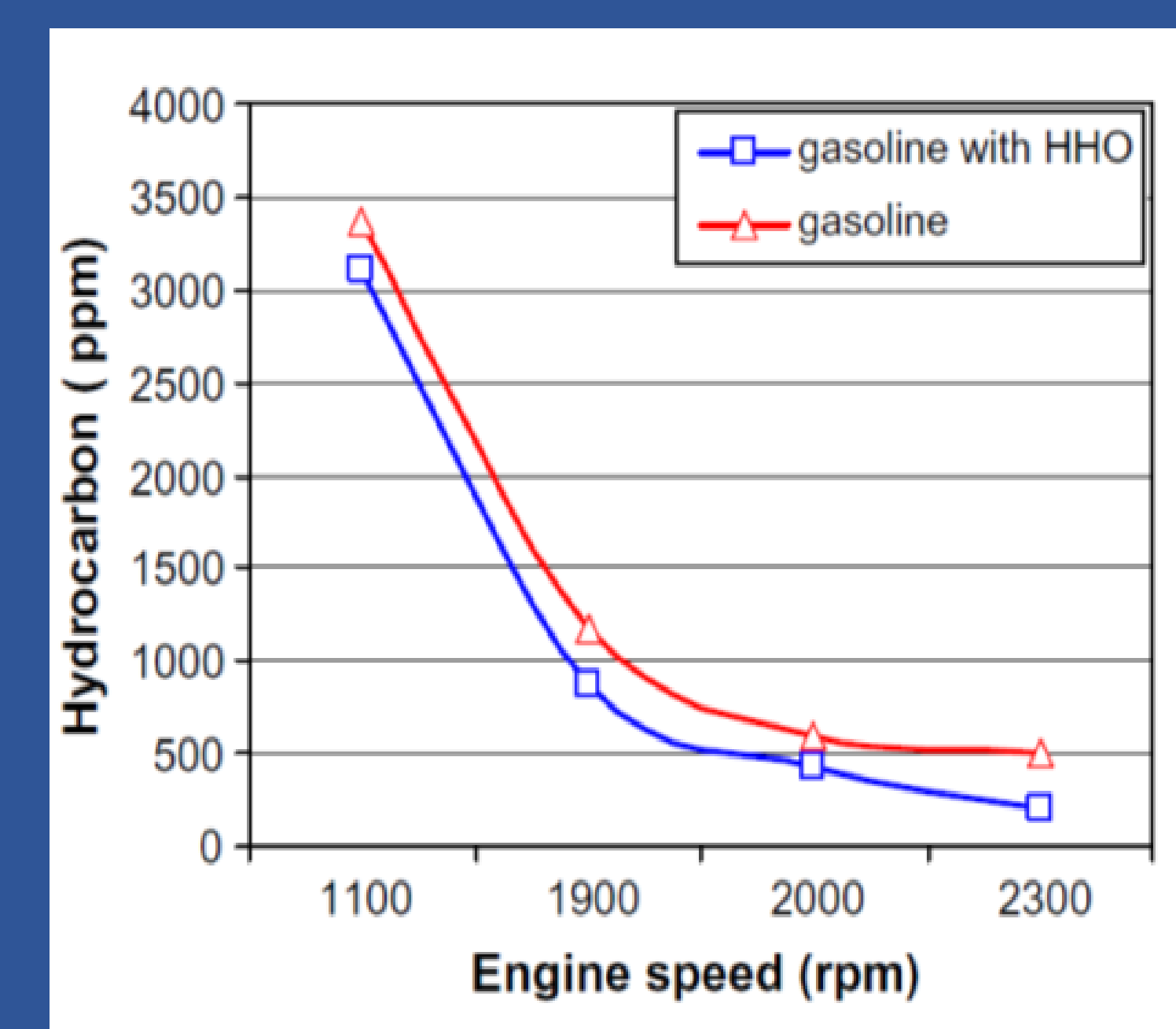
Table 3: Hydrogen + Gasoline Combustion Engines Emission Summary



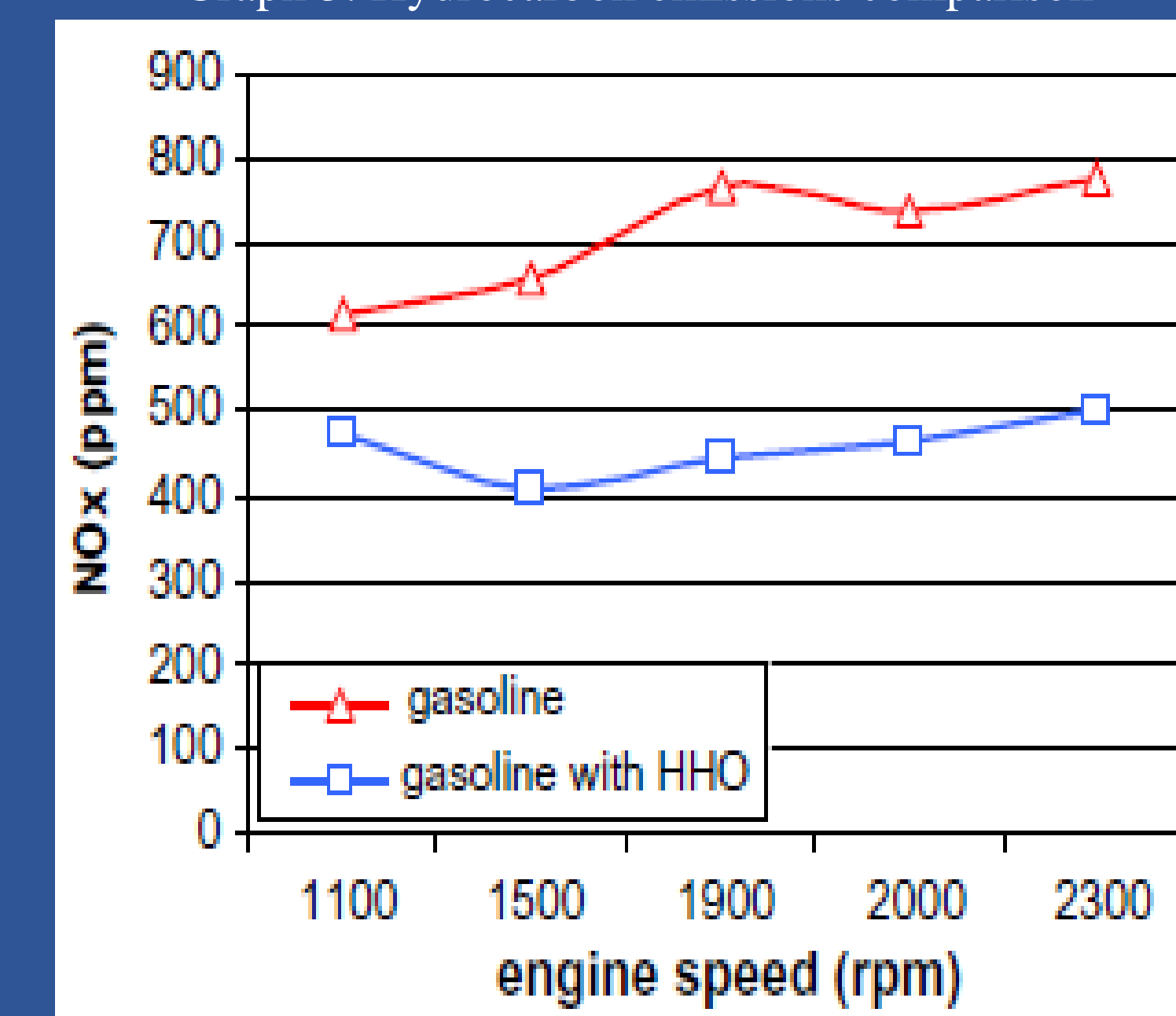
Graph 1: CO emissions comparison



Graph 2: CO₂ emissions comparison



Graph 3: Hydrocarbon emissions comparison



Graph 4: NO_x emissions comparison