# Advantages of hydrogen gas turbines

Combined cycle gas turbines are already the cleanest form of thermal power generation but combusting hydrogen instead of natural gas would make it carbon free and unlike wind and solar energy, the generated power can be dispatched at will and supplied continuously. Hydrogen gas turbines would, in fact, complement the intermittent nature of wind and solar power since they can be used as back-up power with the green hydrogen that is produced via electrolysis process with excess renewable power during abundant periods of wind and daylight. Blue hydrogen, produced by natural gas reformation, can also be a carbon free resource for gas turbines if carbon capture technology is utilized. All in all, hydrogen gas turbines can be an enabler for long term energy storage.

**Using the current natural gas infrastructure**

Gas turbines use the robust and flexible natural gas infrastructure to source their fuel. With little to no modifications a blend of hydrogen with natural gas can be transported within this existing infrastructure which makes the entire system reusable without extreme capital costs. Some countries such as The Netherlands, have already inject up to 20% hydrogen into their natural gas grid in a pilot project on the Island of Ameland some years ago, so this idea can be extended to other countries to at least start burning a blend of natural gas and hydrogen in gas turbines to reduce carbon emissions. However, new piping infrastructure would be necessary for 100% hydrogen transport but combusting hydrogen at the point of production would be a solution to this problem during the initial phase.

**Modifying existing gas turbine technology**

There is no necessity to design and manufacture entirely new gas turbines for hydrogen combustion. The sole component to be modified is the combustor so, theoretically, most of the existing gas turbines can be retrofitted to either partially or fully burn hydrogen. This conversion would not only avoid large capital spending but also save time in switching large fleets of current gas turbines to hydrogen. An additional major benefit of this would be a new lifeline to existing state-of-the-art gas turbines that are sitting idle or being underutilized in many European countries. This would also make a significant contribution to society and industry as the workforce is either being laid off or shifting to other sectors.

**100% emission compliance**

Major OEMs are working on development of dry low NOx burners for hydrogen gas turbines which is mostly standard on natural gas burning turbines. Comparing the current turbines to hydrogen turbines, both with dry low NOx burners, thermal efficiency and power output would be very similar provided that the fuel system is modified to supply larger volumes of hydrogen due to its small molecule size. Since the turbine inlet temperature would stay unchanged, no adverse effects on the maintenance of the existing equipment are expected either.

**Sector coupling for deeper decarbonization**

Heating sector is one of the largest carbon emitters worldwide and hydrogen gas turbines can also be used as combined heat and power plants which would be a very efficient way to decarbonize the heating infrastructure. Coupling hydrogen gas turbines with not only the (district) heating sector, but also other industries (e.g. chemicals, refineries) further decarbonization can be realized through efficiency gains over different end-user sectors.

Last but not least, unlike fuel cell vehicles, hydrogen gas turbines would consume huge amounts of low purity hydrogen generating large and stable mass demand that can contribute to the reduction of hydrogen production costs. In this regard, governmental funding schemes for gas turbine R&D in Europe and Japan can be key contributor towards a hydrogen society.

Source 1: <https://energiekaart.net/initiatieven/duurzaam-ameland-power2gas/>

Source 2: <https://www.swansea.ac.uk/press-office/latest-research/30oftheuksnaturalgascouldbereplacedbyhydrogencuttingcarbonemissions.php>