PRODUCT INFORMATION
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Evolving towards a fossil-free tomorrow.

Reducing emissions and GHG throughout all applications ranks among Woodward L'Orange's top priorities.

To achieve the Paris agreement regarding the emission of greenhouse gases (GHG), the IMO aims to reduce emissions of the marine industry by 50% by 2050 compared to 2008. The pressure to decarbonize is clearly increasing. This article offers an overview of how to select the right Power-to-X (PtX) technologies for a given application and what the choices and benefits are, using a PtX fuel in an internal combustion engine.

The costs for the power generation from renewable energy sources have been plummeting for years. In most regions of the world, they are now cost-competitive even without subsidies. The increasing amount of wind and solar power calls for new technologies to either store large amounts of electric energy or to convert it to chemical substances as synthetic fuels.

It can be expected, that over the next years, hydrogen technologies and Power-to-X (PtX) technologies will follow a strong cost decline as they scale up rapidly. On the basis of green hydrogen, it will be possible to create cost-competitive synthetic fuels with zero carbon footprint. These synthetic fuels can be used to achieve a dramatic reduction of GHG. This is especially the case in applications where a direct electrification and battery electric drives are not feasible.

Challenges facing the marine industry

The shipping industry is a large field of such applications. And there are various PtX fuels currently being investigated. From the perspective of being GHG-neutral, they all have one commonality: they are produced from green hydrogen. Converting hydrogen to more complex chemicals improves the ease to store but also increases the total costs and energy demand of production, especially if carbon capture is needed to generate hydro-carbon fuels.

Fig. 1 highlights how much fuel volume is necessary to store a certain amount of energy. It can be seen, that for LNG, Methanol and Ammonia, the volume is almost twice that of Diesel or heavy fuel oil (HFO). For hydrogen, both liquid and compressed, the required volume is even larger. The characteristics of the applications determine if the benefit of lower fuel costs compensate for the higher efforts for hydrogen storage.

Fig. 2 illustrates a systematic approach to determining the best PtX technologies for different applications. For short-range and especially highly utilized applications, direct electrification or a fuel cell might be the best solution. For many long-range applications, a retrofitted or new internal combustion engine is more feasible. In these applications, the utilization (fuel consumption) determines if the focus is on fuel cost or easier fuel handling. Ammonia produced with nitrogen is expected to be cheaper than Methanol produced with CO_2.

Woodward L'Orange's green roadmap

Woodward L'Orange offers a broad range of injection technologies that are designed or adapted to inject synthetic fuels, either gaseous or liquid. For many years, the SOGAV port fuel injector is used for applications where gaseous fuels need to be injected at low pressure upstream of the cylinder intake valves. It offers a direct actuation and is therefore an easy to use and robust injection solution. With a virtual sensor included, it is possible to monitor in real time the position of the valve. This makes it a good solution for pure gas or dual-fuel engines. As ignition source, these low-pressure dual-fuel engines rely on Woodward L'Orange's diesel injectors that can inject the smallest quantities of fuel with extreme precision while being able to run at full power in diesel-mode.

For high-pressure dual fuel applications, Woodward L'Orange recently introduced the new high-pressure dual-fuel injector family. It allows the injection of both, diesel fuel at up to 2200 bar and a second/PtX fuel at 600 bar directly into the cylinder. This allows for a diesel-like characteristic of the engine at highest efficiencies and power densities. The engine can be operated with both fuels at 100% load.

Woodward is continuously extending its portfolio of injection technologies to serve the broad range of PtX applications. To fill the gap between high-pressure dual-fuel and port fuel injection, the company is currently working on a flexible medium-pressure direct injector platform. As can be seen in Fig. 3, this injector can be designed to either inject the fuel at pressures of 20 bar or up to 100 bar.

During the coming decade, the regulatory and market environment will undergo severe changes. Choosing a flexible engine technology today offers the opportunity to change to other fuels during the long lifetime of an engine. Different pathways for such a fuel bridging are shown in Fig. 4. Woodward L'Orange injectors can be designed to allow a fuel switch with minor changes.

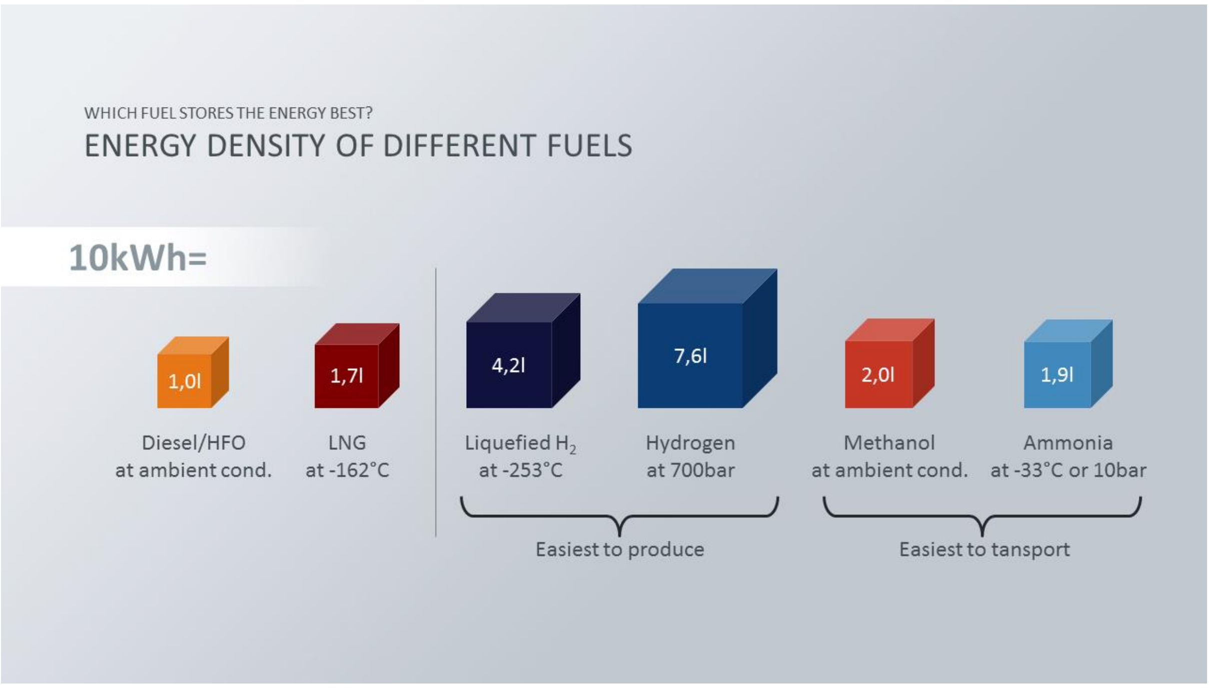

Fig. 1: Required volume in liter of PtX fuel for storage of 10kWh (without a storage tank)

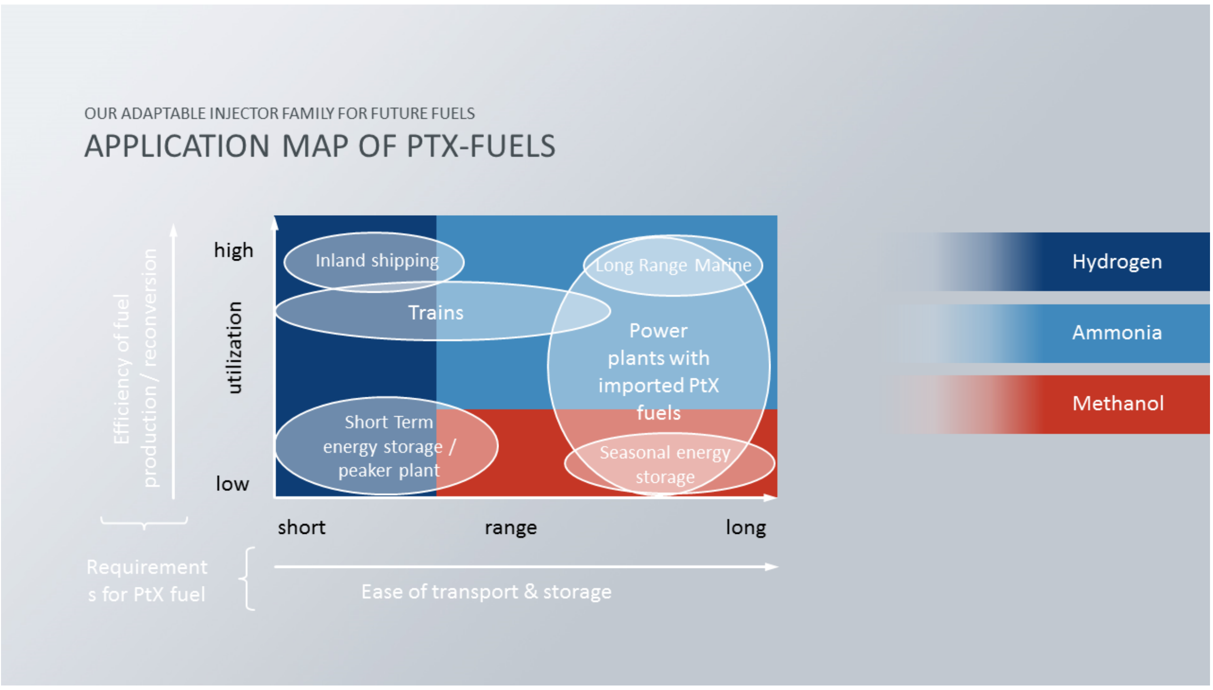

Fig. 2: Schematic matrix for the selection of a PtX technology

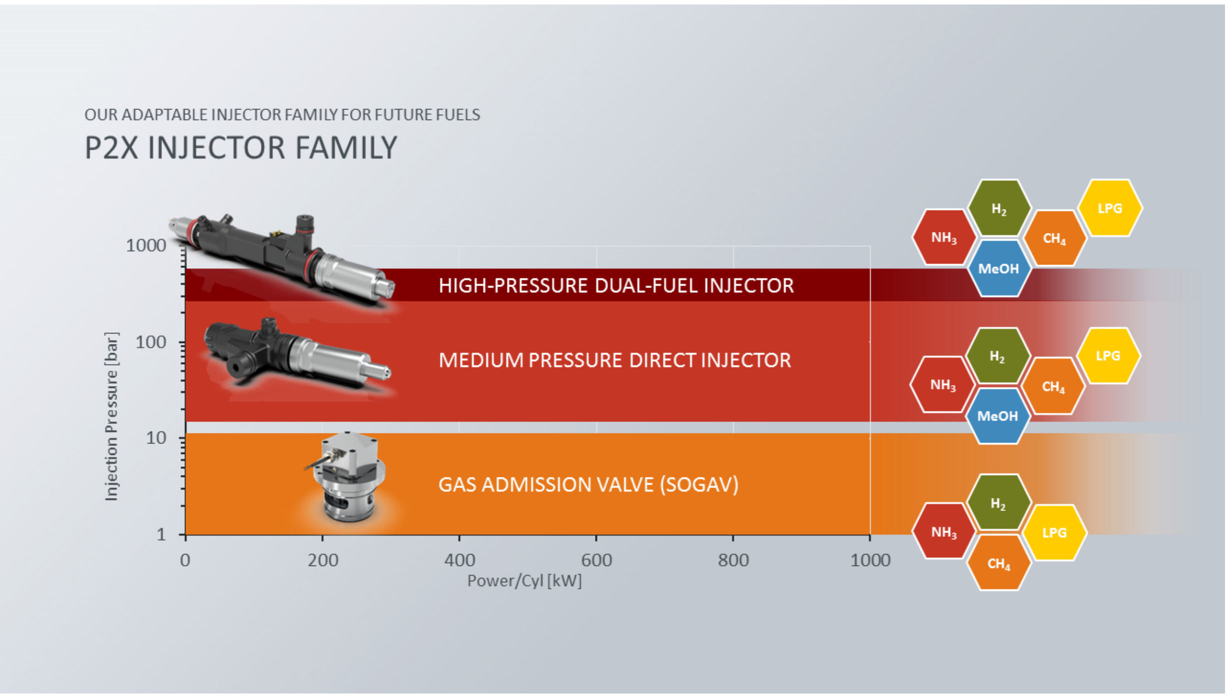

Fig. 3: Overview of Woodward's PtX injectors and valves

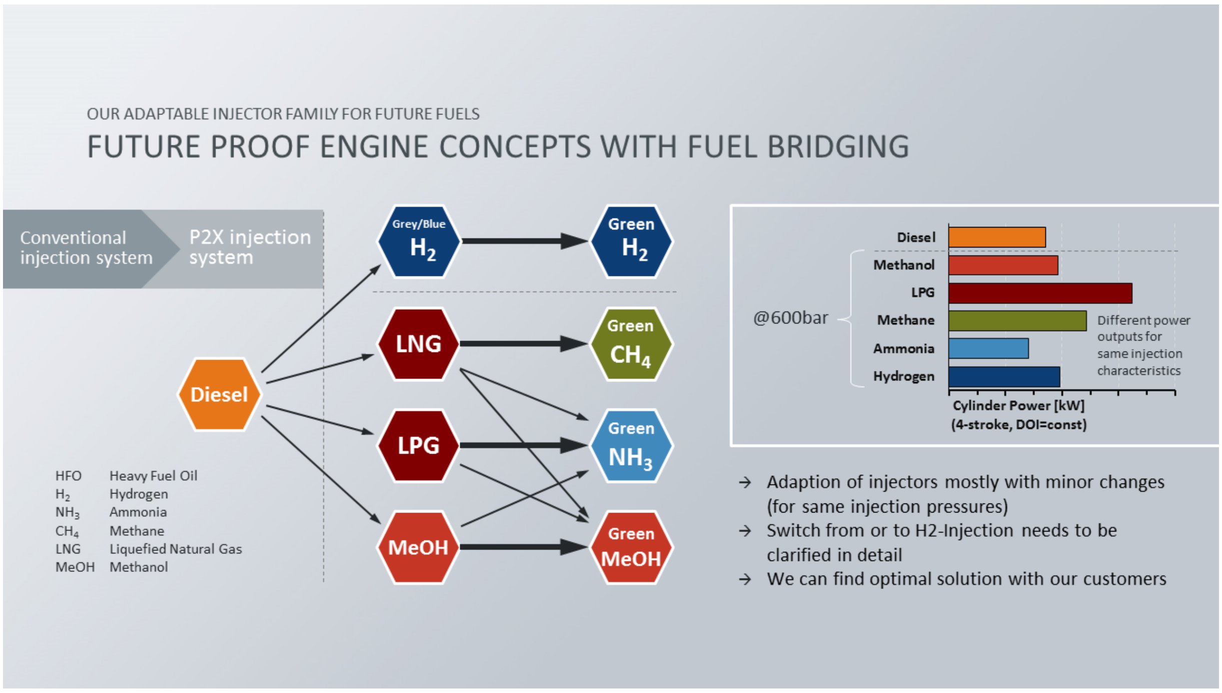

Fig. 4: Possible fuel transition pathways

Fig. 5: Evolving towards a fossil-free tomorrow with our high-pressure dual-fuel solutions