



CAPITALIZE ON
MAXIMUM
FLEXIBILITY

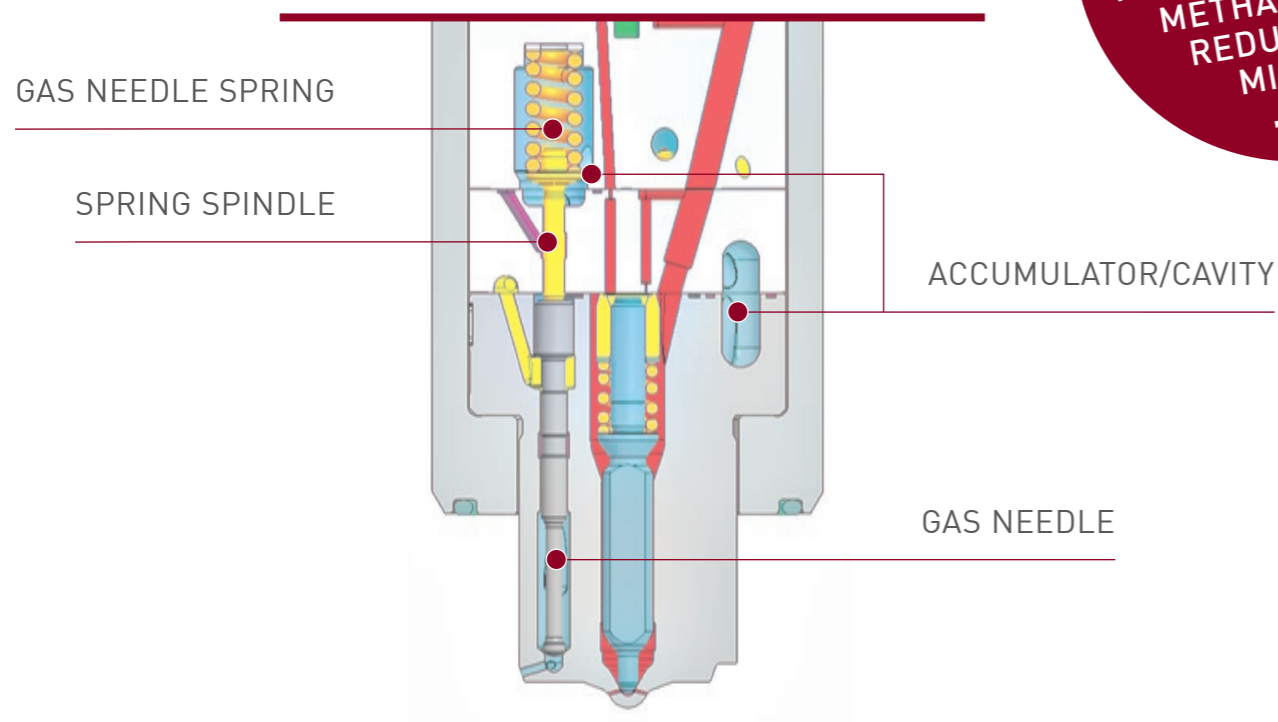
FUTURE-PROOF YOUR TECHNOLOGY:

HIGH-PRESSURE DUAL-FUEL INJECTORS

MAXIMIZE YOUR FUEL OPTIONS WITH STATE-OF-THE-ART HIGH-PRESSURE DUAL-FUEL TECHNOLOGY (HPDF)

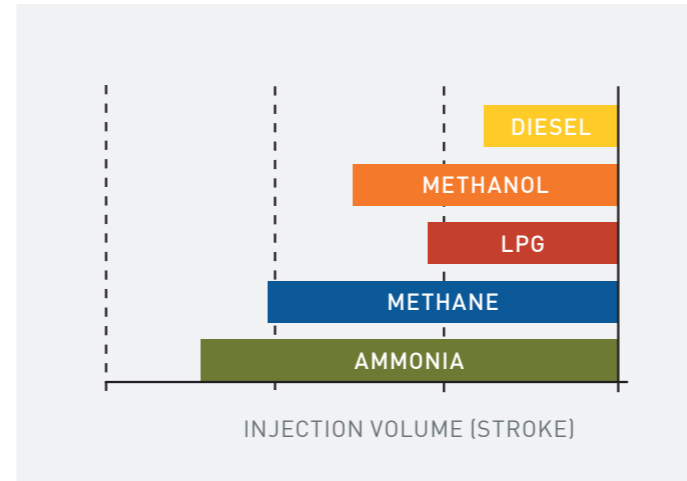
The IMO's ambitious vision of reducing greenhouse gas (GHG) emissions from international shipping by at least 50% by 2050 (compared to 2008) is leading OEMs to question which fuels will be used in the marine sector in the future. Upcoming regulations will deeply impact all segments. And we are facing current market uncertainty as to which fuel and engine technologies will deliver the most future-proof investment.

With this in mind, Woodward L'Orange has developed a family of advanced high-pressure dual-fuel injectors that are ready to handle several different fuel options; they will even effectively deal with fuel switches during the engine's lifetime. This state-of-the-art HPDF injector technology enables the use of most greenhouse-gas-reducing PtX fuels (Power-to-X fuels) currently under discussion.



THE MAIN FUEL NEEDLES ARE ACTUATED BY AN INDEPENDENT HYDRAULIC VALVE WHICH CAN BE LOCATED FLEXIBLY TO IDEALLY SUIT THE CUSTOMER'S ENGINE CONCEPT.

OPTIMIZED COMPONENT PERFORMANCE, PLUS: VERY LOW METHANE EMISSIONS, METHANE SLIP IS REDUCED TO A MINIMUM



COMPARISON OF EQUIVALENT INJECTION QUANTITIES OF VARIOUS LOW-CALORIC FUELS



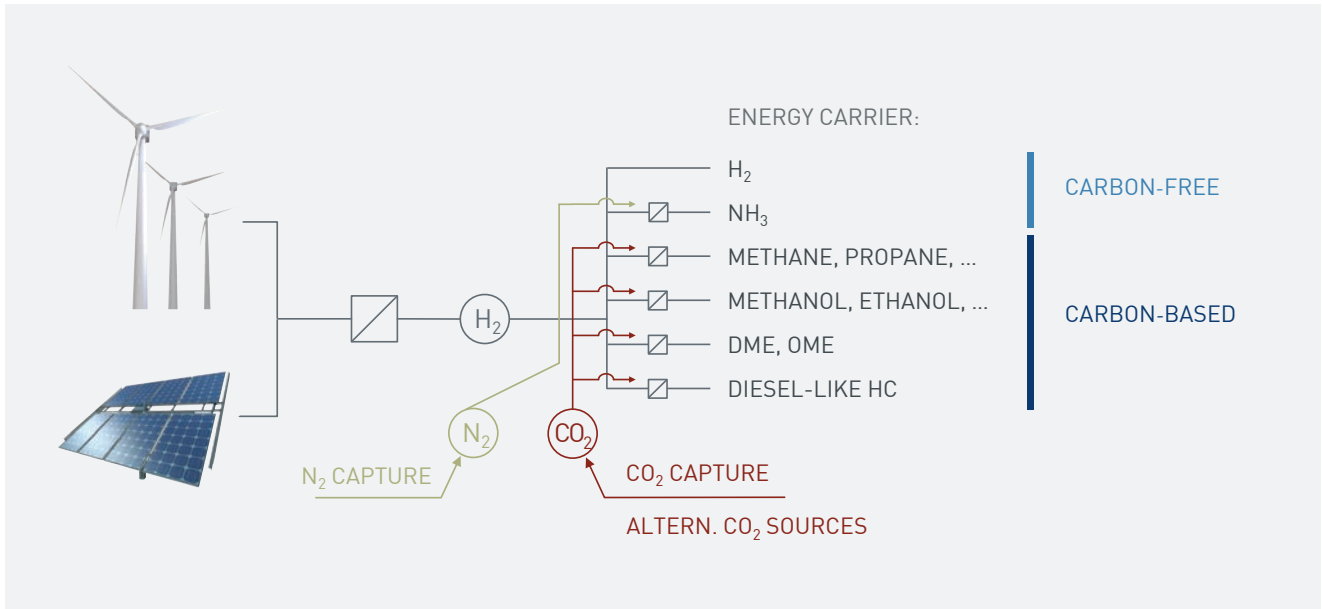
NOZZLE WITH THREE CONCENTRIC GAS NEEDLES AND ONE CENTRAL DIESEL NEEDLE

HPDF INJECTOR TECHNOLOGY AT ITS MOST FLEXIBLE – YOU'LL CAPITALIZE ON MANY BENEFITS

Woodward L'Orange's new family of high-pressure dual-fuel injectors is the enabling technology for new mobile gas engines with close-to-zero methane slip and for most e-fuels currently being considered to reduce greenhouse gas emissions.

- Common-rail diesel side with 100% diesel capability and pressures of up to 2,200 bar: ensure 100% backup power at outstanding performance and a fully optimized combustion process
- High gas pressures of up to 600 bar: enable a defined mass flow throughout the injection and fully optimized gas combustion
- Compact, space-saving injector design: suits the vast majority of engine configurations
- High-level fuel flexibility: ensures easy adaptation to future-proof your investment

This technology allows the design of engines with diesel-like power densities and dynamic performance. The high-pressure dual-fuel technology is also ready to be used with other alternative fossil fuels such as LPG, or regeneratively produced future fuels, such as methanol or ammonia.



Woodward L'Orange, as long-time leader in its segment, represents the broad range of injection technology products for off-highway applications. Our systems supply large engines with an enormous variety of fuels and additives. Gas and dual-fuel operation is acknowledged as being one of the most innovative technologies available today for a more flexible, more efficient and lower-emission use of large engines. We are also prepared for tomorrow's fuels, such as PtX. And we supply injection systems for some of the most successful dual-fuel engines on the market.

What OEMs demand from us is clear: more efficiency, lower emissions. These two criteria are the measure of all things in everything we do – from complete injection systems to individual components and the smallest spare parts. And this is how we set benchmarks again and again in terms of cost-effectiveness, availability, reliability and environmental compatibility.



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