

LINERLESS COMPOSITE PRESSURE VESSELS



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MOTIVATION – THE QUEST FOR ZERO CARBON FUEL

As the world moves towards zero carbon a solution must be found for the transport sector.

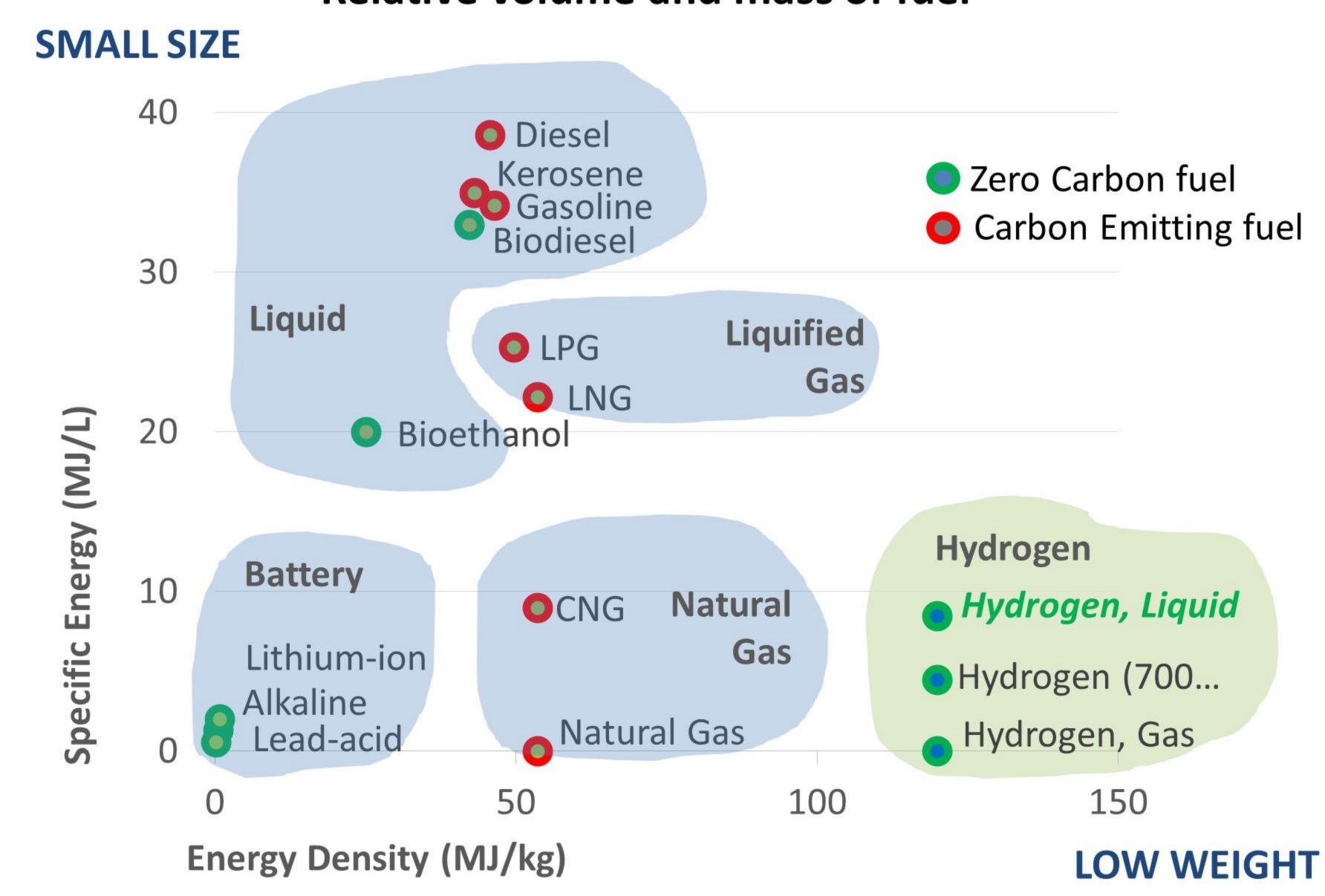
UK CO² Emissions by Sector 2018

Transport		27%
Energy supply		23%
Business	17%	
Residential	15%	
Agriculture 10%		
4% Waste m	anagement	
2% Industrial pro	cesses	
2% Public		

Hydrogen is a strong candidate zero carbon fuel for the transport sector due to a high energy density for a given mass.

vessels are a key enabler for hydrogen storage.

Relative volume and mass of fuel



CHALLENGE – LIGHTWEIGHT HYDROGEN STORAGE VESSELS

Hydrogen is usually stored as a cryogenic liquid at -250°C or a high pressure gas at 700 bar. Pressure vessels for

Types of pressure vessels

Type IV
Composite overwrapped
Polymer liner

Type III
Composite overwrapped
Metal liner

Type II
Composite overwrapped
Metal

Type II
Metal

Low maturity developing technology for liquid storage in aviation and space.

- Mature massproduced technology.
- Type IV used for gas storage in hydrogen fuel cell cars.

CHALLENGES IN CRYOGENIC STORAGE

LAMINATE

- High Thermal Stress within the composite.
- Coefficients of Thermal Expansion
 Vary from layer to layer due to
 different angles.
- Microcracking induced through cryogenic cycling causes leakage.

END BOSS

- Leakage Path between boss and laminate.
- Thermal Expansion & Bonding compatibility between material.

END DOME

- Cost & Weight impacted by excess material.
- Unnecessary Material in dome regions due to angle constraints and overlap from filament winding.

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