

**GENERAL MOTORS
HYDROGEN STORAGE REQUIREMENTS
FOR FUEL CELL VEHICLES**

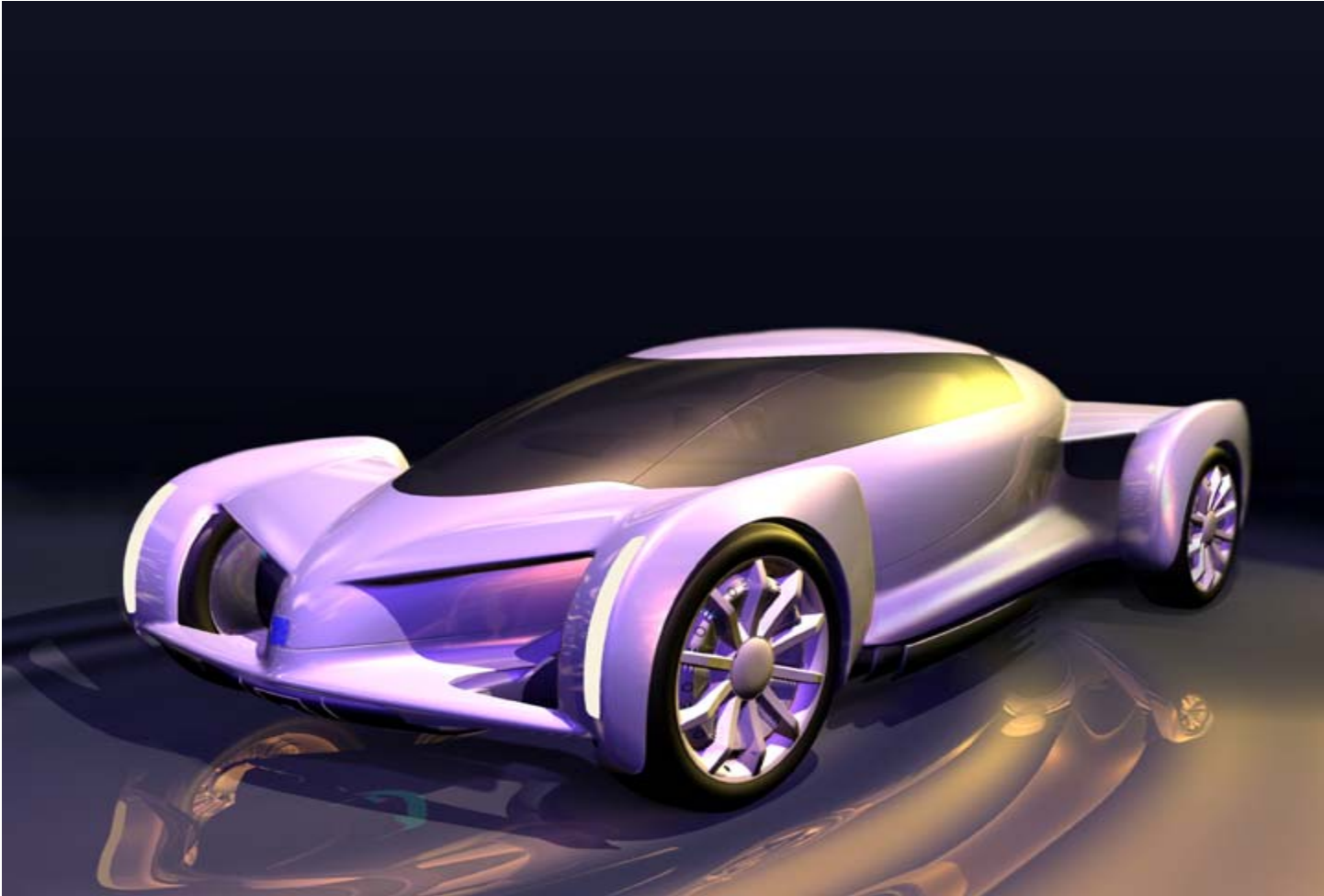
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General Motors Fuel Cell Vehicles

- GM fuel cell vehicle Goal
 - be the first to profitably sell one million fuel cell vehicles
- Fuel cell powerplant must be suitable for a broad range of light-duty vehicles (not just niche)
- UNCOMPROMISED performance & reliability are REQUIRED
- SAFETY IS A GIVEN
- Evolutionary and Revolutionary vehicle designs are included—GM AUTONOMY—as long as the customer is (more than) satisfied

GENERAL MOTORS *AUTONOMY*



GENERAL MOTORS *AUTONOMY*



General Motors Fuel Cell Vehicles

- Focus on PEM fuel cell technology
- Must consider entire hydrogen storage & (unique) fuel delivery systems, including ALL required onboard hardware (e.g., heat exchangers)
- SAFETY IS A GIVEN

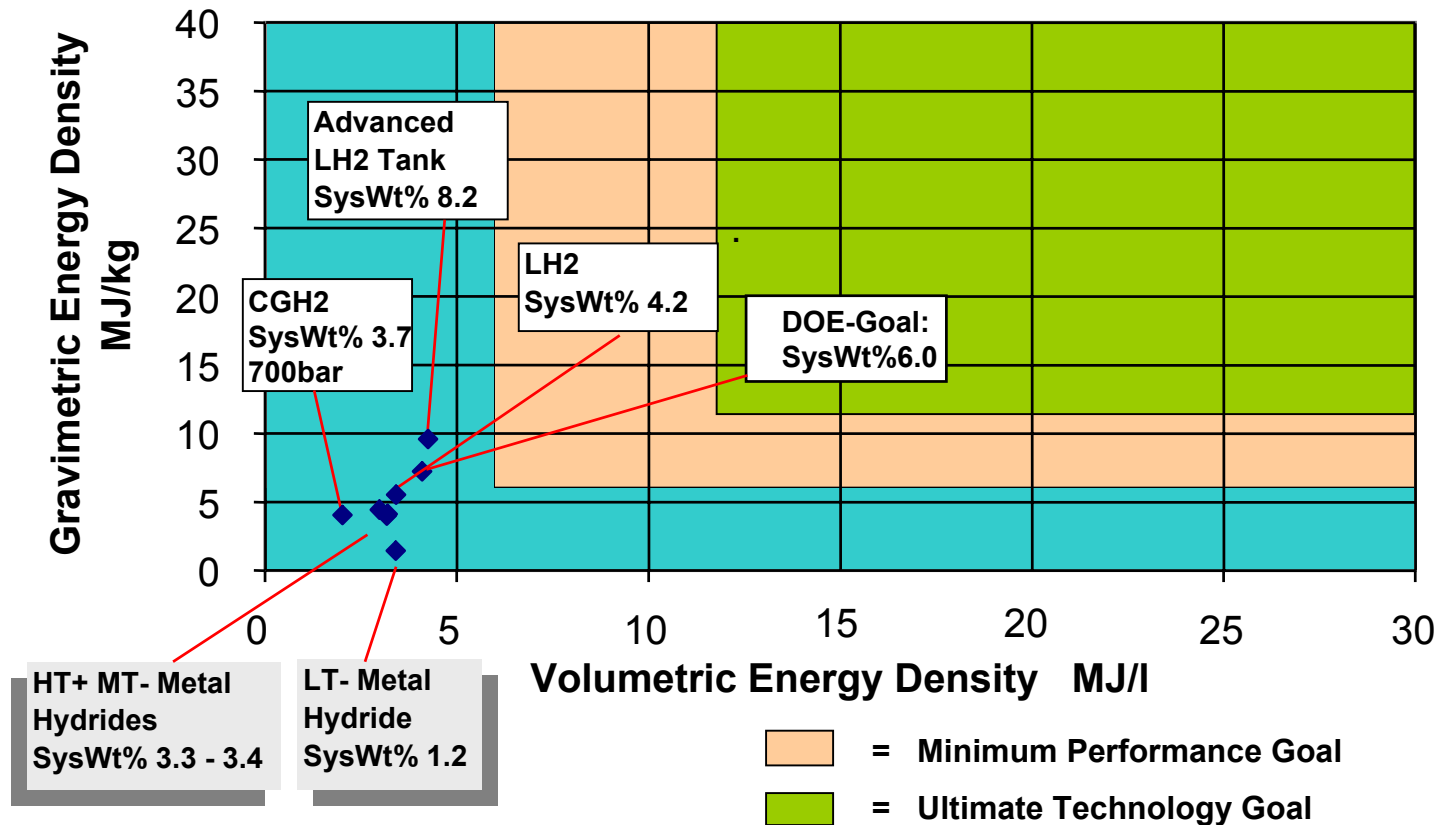
General Motors

Hydrogen Storage Parameters

<u>METRIC</u>	<u>GOAL</u>
• Mass Energy Density (MJ/kg)	See Graph
• Volumetric Energy Density (MJ/ℓ)	See Graph
• Refueling Time (min)	< 5 min
• Durability (total miles maintaining 80% capacity)	150,000 miles
• Hydrogen Release Rate [g/(s*kW _{stack})]	.025 (1.5 g/s @ 60 kW)
• H ₂ Release Temperature (°C)	< 80°C
• Energy Penalty for H ₂ Release (%)	< 5%
• On-Board Heat Dissipation During Refueling (kW)	0

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Gravimetric Energy Density vs. Volumetric Energy Density of Fuel Cell Hydrogen Storage Systems



General Motors Hydrogen Storage System Summary

- Must include ALL required hydrogen storage & (unique) fuel delivery system support hardware (e.g., heat exchangers)
- Must be robust—very broad customer usage
- Must be compatible with a broad range of vehicle styles—packaging constraints
- Must be affordable
- SAFETY IS A GIVEN