

FIBER BULK GASEOUS CARRIERS

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HEXAGON COMPOSITES HIGH PRESSURE PRODUCTS



- Lightweight composite cylinders for the storage and transportation of gas under pressure
 - Compressed natural gas
 - Compressed hydrogen gas
- Vehicle fuel cylinders
 - Passenger cars
 - Buses and
 - Heavy-duty vehicles
- Transport and storage cylinders
 - Bulk hauling trailers and modules
 - Ground storage systems



- Figures with “NG-__” titles taken from “National Petroleum Council Future Transportation Fuels Study; Natural Gas Analysis”

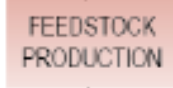


HOW DOES BULK HAULING FIT IN?

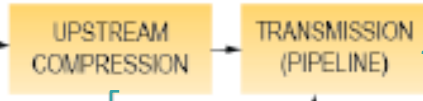
Modification of “Figure NG-7. Natural Gas for Transportation Supply Chain” to Include Bulk Hauling of CNG



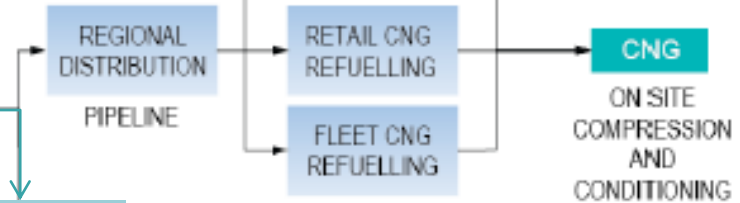
PRODUCTION



TRANSMISSION

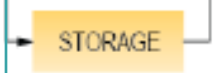


DISTRIBUTION



CNG

ON SITE COMPRESSION AND CONDITIONING



ON SITE COMPRESSION AND CONDITIONING



“VIRTUAL PIPELINE”

“DAUGHTER STATION”



ON SITE COMPRESSION AND CONDITIONING

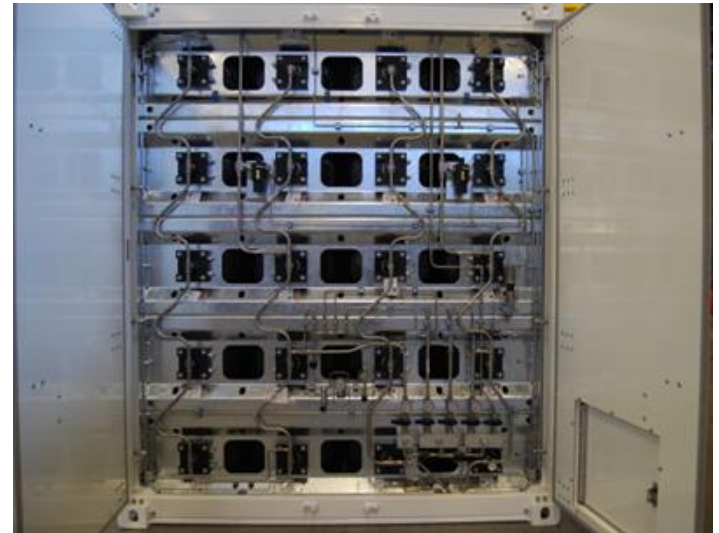




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INTERNAL CHALLENGES

- Issues over which developers/industry have some degree of influence
- Operating pressures of the infrastructure sub-systems
 - Compression
 - Storage
 - Transportation
 - Vehicles
- Learning from experience
 - Alignment of certification/qualification requirements with real world experience
 - EG, a system approach to impact and fire protection is only way to optimize overall cost and safety reduction
 - “Hand in hand, eyes wide open, nothing sacred”
- Materials science at every level and in every component
- Managing expectations





EXTERNAL CHALLENGES

- Issues over which developers/industry of transportation/storage systems have little or no influence.
- Carbon fiber, forging costs
- Excise taxes on trailers
- State-by-state regulation within the United States
 - Allowable Gross Vehicle Weight (GVW)
 - Public safety (State Fire Marshalls)
- Business model not well understood by stakeholders
 - Expansion of infrastructure
 - Expansion of product use

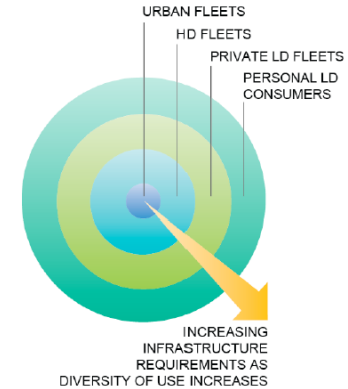
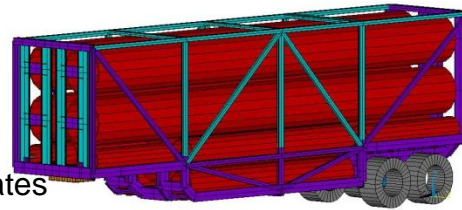
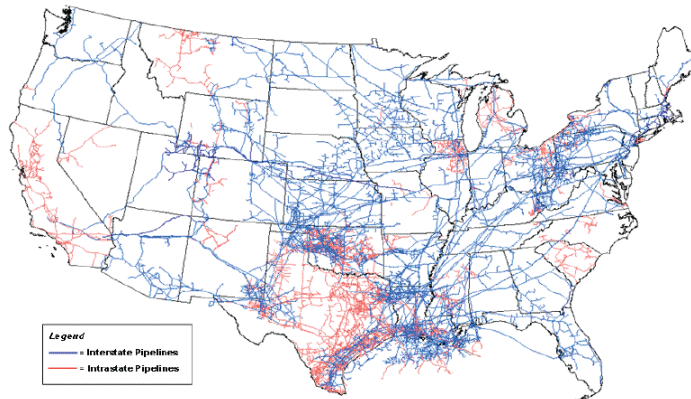


Figure NG-16. Infrastructure Challenge Increases with Market Expansion



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System



RESEARCH, DEVELOPMENT & DEPLOYMENT NEEDS



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- Suggestions for additional research, development and deployment (RD&D) activities which will help overcome those challenges in the near-term (2014-2016), mid-term (2017-2020), and long term 2020+.
- Field trials - experience is critical
 - The sooner you start using real equipment, the sooner you will know what your real issues are
 - You haven't thought of everything ...
- Get a head start on working with regulators, agencies and businesses
- Materials research must remain a priority
 - "Building block" approach
 - Laboratory through actual service

