This is the 7th
Clean Fuels Consulting
Critical Issues Workshops

• 2008: **CNG & H2 Cylinders**: Opportunities, Challenges & Strategies
• 2009: **LNG is HOT**: Opportunities, Challenges & Strategies as a Vehicle Fuel
• 2010: **Dual-Fuel**: Opportunities, Challenges & Strategies to Expand the Market
• 2011: **Chickens & Eggs**: Opportunities, Challenges & Strategies Building the Infrastructure for Natural Gas Vehicles
• 2013: **Poli-techs standards and regulations**: Creating a Standards & Regulatory Roadmap for Gaseous Fuel Vehicles
• 2014: **CNG & LNG Safety**: Perception & Reality
• 2016: **CNG Cylinders & LNG Tanks**: Opportunities, Challenges & Innovations
Thanks to the Participants

• Challenges in Brussels with terrorist attacks & subsequent transportation problems
  - A few participants dropped out
  - Some presenters have changed & a few presentations will be done remotely but the information is the same; as intended!

• Crowded conference and workshop calendar – NGVs and LNG increasingly popular

• But… our knowledgeable and experienced speakers & participants will make for an engaging workshop opportunity
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Structure of the Workshop

CNG CYLINDERS
Trucks & Ships

LNG TANKS
Trucks & Ships

WEDNESDAY
WHERE WE HAVE BEEN
WHERE WE ARE TODAY
ISSUES TO ADDRESS & RESOLVE

THURSDAY
NEW CONCEPTS
INNOVATIONS & MOVING TO MARKET
ISSUES TO ADDRESS & RESOLVE
Motivations for this Workshop

• Critical Issues are facing the industry that need to be addressed.
  - Harmonization of standards and regulations is needed
  - New standards/regulations needed in the marine market, in particular
  - Concerns about over-pressurization
  - Concerns about relief devices and related system hardware
  - Continued issues about safety from cradle to grave for CNG & LNG
• Innovations coming into the market for CNG and LNG
  - The U.S. & Europe are funding new gas storage technologies, but…
  - Standards and regulations likely must be adapted and amended
### Program Goal

Payback less than 5 years for light duty NGVs with conformable tanks and at-home refueling

### Compressors

- Liquid piston
- Multi-stage linear piston
- Cryocooled-sorbent
- Dual engine-compressor

### Sorbents

- Metal organic frameworks
- Nanovalved
- Containerless tank

### Tanks

- Superplastic forming
- 3-D squeeze cast
- Cellular module
- Intestine storage

Directive 2014/04
Deployment of the Alternative Fuels Infrastructure’ originally specified development of CNG & LNG stations for road and ports; also EV charging points.

The specific targets were removed in the final version.

Still the mandate exists to 2020, 2025 and 2030 to install ‘appropriate (or sufficient) numbers’ of fuelling stations.

Sources: EU documents Ten-T; AFV Infrastructure policy impacts; etc.

Clean Power for Transport: Ambitions for alternative fuel networks in Europe

Share of TEN-T contribution* by transport mode

€335.8m
Innovation & Networks Executive Agency (INEA) replaced TEN-T EA as of 1 Jan 2014

• Created to manage the technical and financial implementation of the TEN-T program
• Budget 2014-2020 = € 34.1 billion (4 times the TEN-T budget)
• Expansion from 100 staff in TEN-T EA to about 300 staff in INEA managing around more than 2000 projects by 2020
Connecting Europe Facility (CEF) & Horizon 2020 can fund alternative fuel & NGV/LNG projects.

CEF Transport

Challenges Smart green and integrated transport

Secure, clean and efficient energy

Mobility for Growth

Smart Cities & communities

Competitive low carbon Energy

Projects involving LNG bunkering
NGV innovative technologies should avoid falling into the Chasm of Commercialisation

Many new technologies and products do not become commercially viable

TIME

INITIAL CONCEPT

RESEARCH

DEVELOPMENT

DEMONSTRATION

FIELD TEST

THE COMMERCIAL MARKET

Chasm of Commercialization
Growth in the demand for CNG Type 1 (all-metal) vessels will dominate, however, there will be increasing demand for vessels that incorporate composites (CNG Types II, III, IV and V)

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Source: Composites Forecasts & Consulting
Demand for LNG trucks also will expand

• China: Very strong growth
  - 2008: 15 LNG stations
  - 2010: 6,800 LNG trucks
  - 2011: 211 LNG stations & 17,500 LNG trucks
  - 2012: 51,000 LNG trucks
  - 2013: 1,800 LNG stations
  - 2014: 60,000 LNG trucks & 40,000 LNG buses

  x 2

• United States 2013: 209 LNG stations & 6,000 LNG HDVs (est. 75% trucks; 25% buses)

• Europe 2014: approximately 50 LNG stations and 1,500 LNG trucks

Source: ECE-TRANS-WP15-98-GE-inf12e, 27 April 2015 (NGV Global responses re LNG safety ADR trucks)
The market for LNG shipping will grow steadily

7th Critical Issues Workshop

CNG Cylinders & LNG Tanks: Opportunities, Challenges & Innovations

13-14 April 2014
Le Chatelain Hotel
Brussels