

# Pre-Normative Research on Gaseous Hydrogen Transfer “HyTransfer”

FCH-JU-2012-1 325277

Sofia Capito

LBST GmbH

[www.hytransfer.eu](http://www.hytransfer.eu)



- Area: Hydrogen Production & Distribution  
Call topic: SP1-JTI-FCH.2012.2.6
- June 2013 - July 2016 → 79% of duration passed
- Budget: 3.1 M€  
FCH JU contribution: 1.6 M€

The aim is to provide recommendations for international regulations, codes and standards (RCS) related to improving the process of filling and emptying hydrogen tanks.

## Coordination



## Industry



## Research & Testing



## Regulation, Codes & Standards



## Funding



Pre-Normative...

...Research...

...for Thermodynamic Optimization of...

... Fast Hydrogen Transfer

Total heat input based calculated pre-cooling demand yields these benefits:

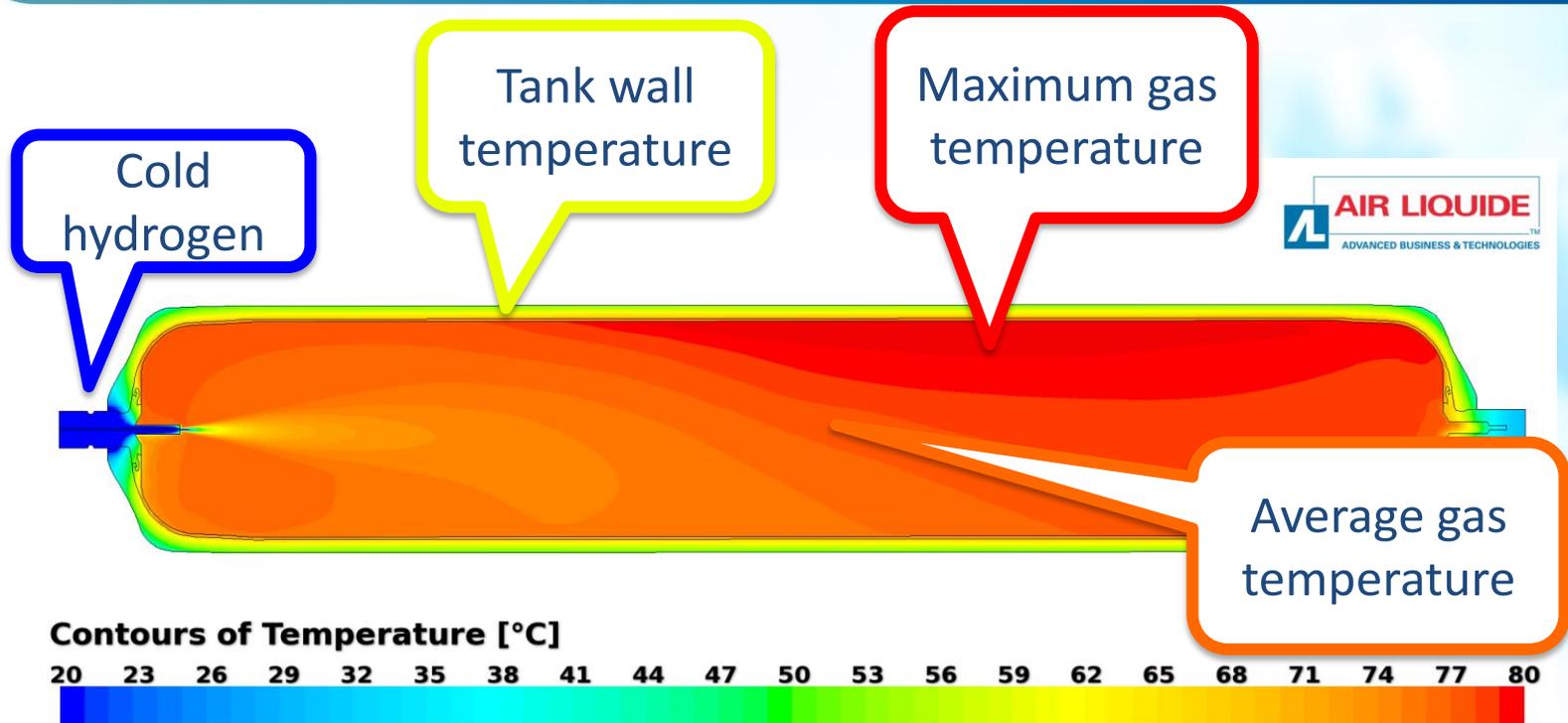
HRS:

- ▶ Reduced CAPEX for hardware
- ▶ Reduced OPEX for electricity and maintenance

Customers:

- ▶ Reduced CAPEX and OPEX could lead to reduced hydrogen prices at the pump
- ▶ Shorter refuelling durations can be realized
- ▶ Increased HRS reliability

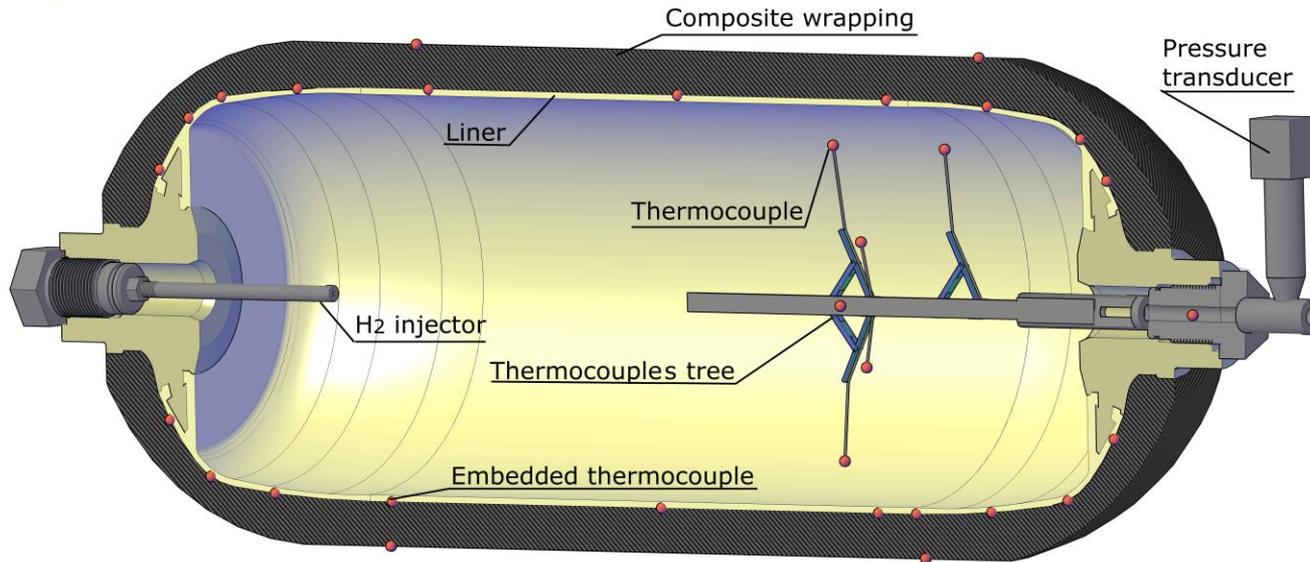
# Heat Exchange Gas/Wall



Tanks are allowed to be operated from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .  
Where is this temperature measured?

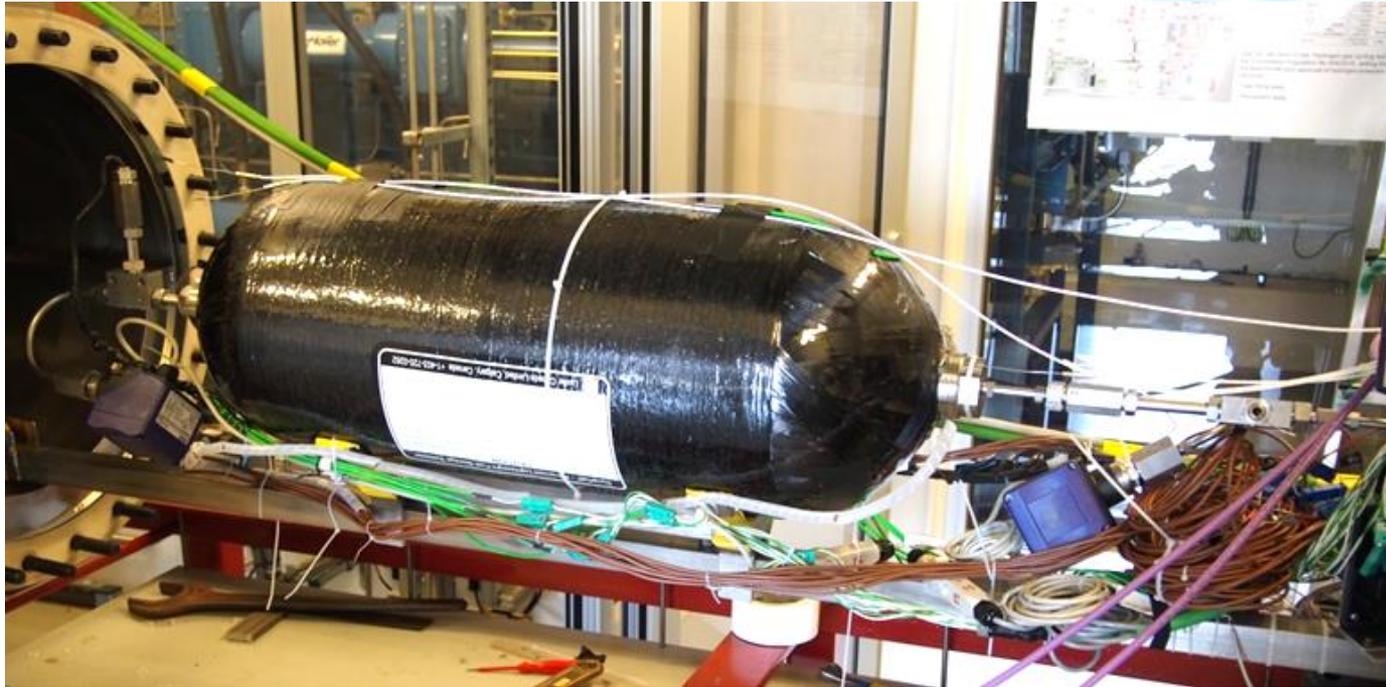
- Today: gas temperature
- HyTransfer: tank wall temperature

HyTransfer instrumented tank



## Temperature sensors:

- 6 or 10 mounted on thermocouple tree inside the gas
- 30 in the wall
- 6 on the outside of the tank wall

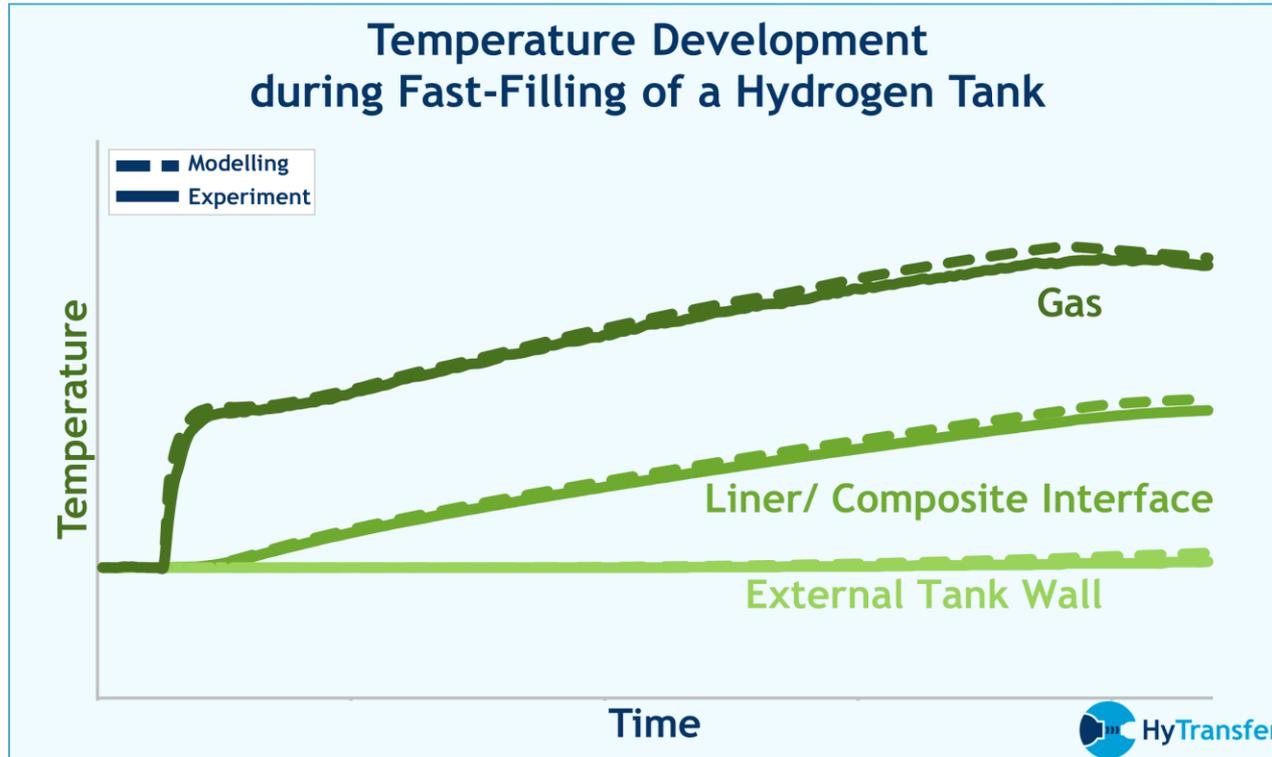


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83 experiments in 3 different labs on 3 different kinds of tanks:

- 40 liter type 3 tank (metal liner)
- 37 liter type 4 tank (plastic liner)
- 531 liter type 4 tank (plastic liner)

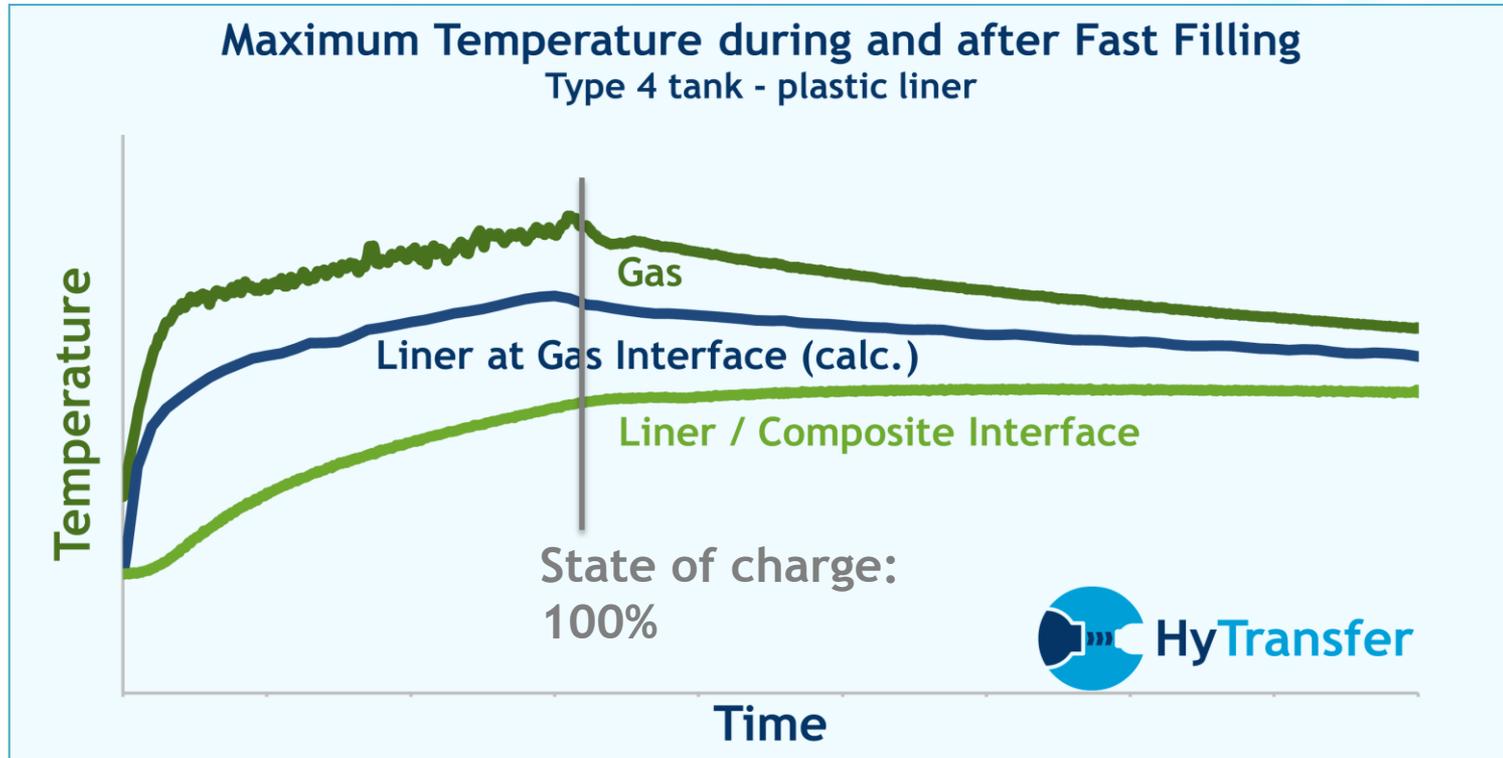
# Model Accuracy



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➔ Deviation between experiments and modelling only around 3 K

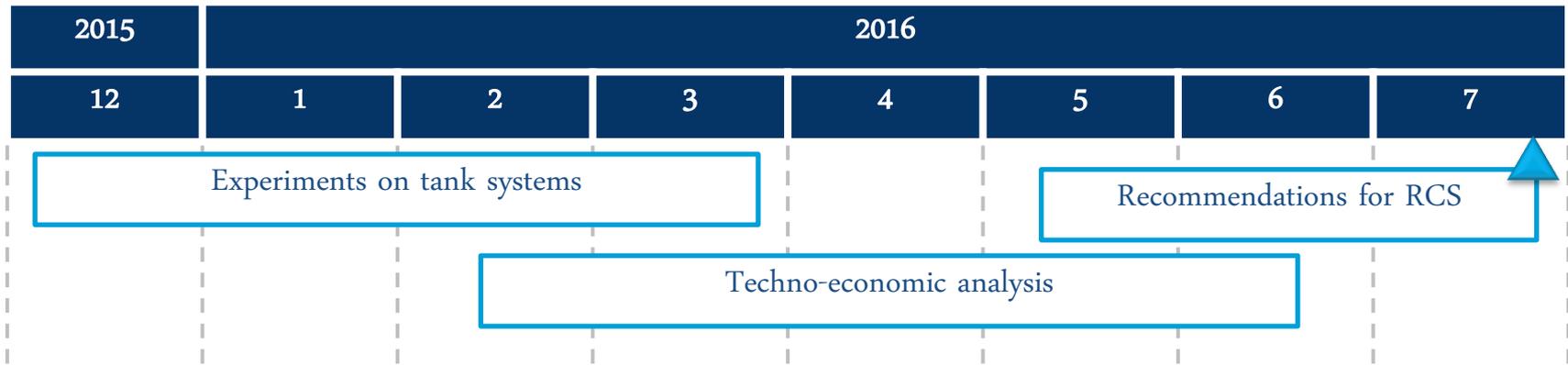
# Temperature Evolution



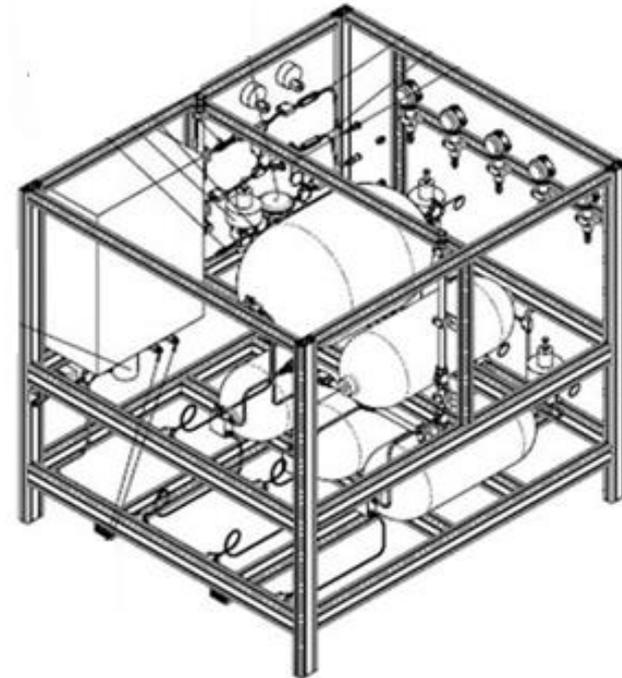
Result from one out of 83 experiments:

Maximum gas temperature is 13 K higher than maximum gas-liner temperature.

# Next Steps



Set-up for experiments on tank systems:



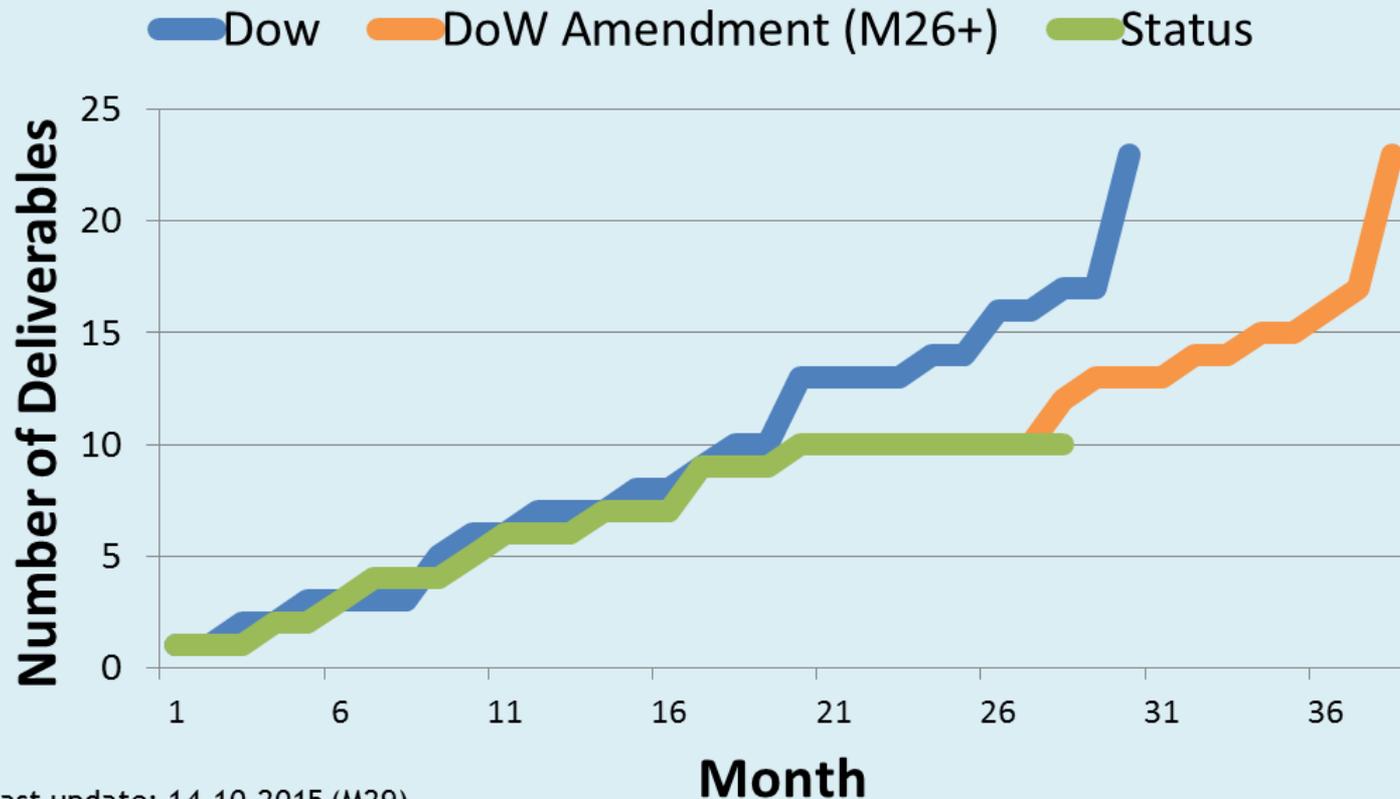
Selected realized risks and ~~mitigation~~ consequence:

- 531 l tank got lost in the mail and re-appeared months later
- Tanks stuck in customs for 2 months
- Tank manufacturer stopped delivering tanks
- Instrumentation defects during experiments
- Increased safety requirements from authorities



Extend project by 8 months  
&  
reach all content related targets

## HyTransfer: Hand in of Deliverables



Last update: 14.10.2015 (M29)

HyTransfer is only funded by FCH JU.

Through the involved partner companies it is strongly interlinked with other projects, committees, organisations:



Public Webinar:  
Friday, 11<sup>th</sup> Dec 2015, 14:00-15:30  
Register online: [www.hytransfer.eu](http://www.hytransfer.eu)

- Target group:
  - RCS hydrogen experts
  - Committees and organisations active in RCS
  - HRS stakeholders such as HRS operators, FCEV OEMs, component manufacturers and gas suppliers
- Coverage:
  - Nearly everyone knows about HyTransfer
  - Nearly every target person knows HyTransfer partners in person
- Methods:
  - Presentations
  - Flyer, website
  - Personal contacts within „hydrogen family“
  - Individual information sessions





Regulations, Codes and Standards (RCS)



An improved refuelling protocol based on HyTransfer results can lead to:

- Earlier business case of HRS due to
  - Reduced CAPEX
  - Reduced OPEX
- Improved customer experience due to
  - Higher HRS reliability
  - Shorter real life refuelling times



Accelerated FCEV market roll-out

Thank you for your attention.

Questions?