

European Hydrogen Emergency Response training programme for First Responders



Hydrogen & FC Feedback

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Introduction



Brief Air Liquide background



- Total Group revenue 2012 : €15.326 billion
 - €7.025 billion from Europe, €3.416 billion from Asia
 - €1.609 billion net profit, 11.9% ROCE
- Present in 80 countries
- 50.000 employees
- Air Liquide's 2012 innovation budget of € 257M
- Sustainable development represents 60% of R&D budget
- 5 strategic growth drivers



Energy



Environment



Health



High-Tech



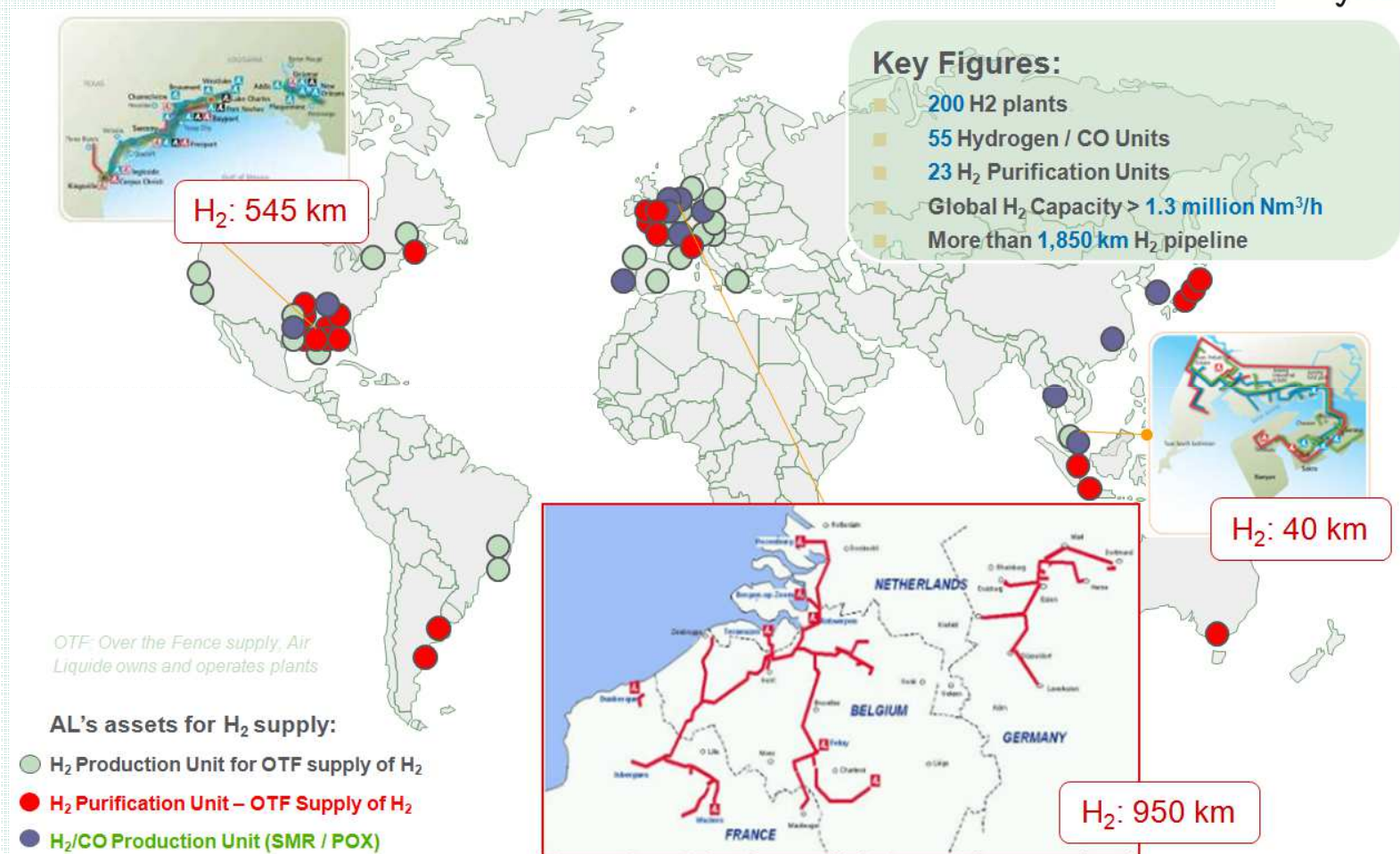
Developing economies



Over 40 years of hydrogen exploitation



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A dedicated organization to efficiently address new markets

- **Air Liquide Advanced Business**

- **Development of** Hydrogen Energy Innovative Offer
- **Marketing and Sales** of hydrogen energy solutions
- **Supply chain** management of the hydrogen systems
- **Customer service and systems maintenance**



- **Axane**

- **10 years of expertise** in PEM fuel cells
- Hydrogen Energy System **development** and **manufacturing**



- **Air Liquide Advanced Technologies, HRS**

- **10 years of expertise and production** of Hydrogen Refueling Stations
- **350 bar and 700 bar** filling technologies



- **Hypulsion**

- **Joint Venture** for Europe's material handling markets between Axane and **Plug Power**,: the **world leader of fuel cells for forklifts trucks**



- **A dedicated H₂ energy R&D team**

Since 2006, in the USA:



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Interesting Incident



Emeryville (CA, USA) – May 4th 2012 :



Internal leak on a release device => **No danger**



Evacuation perimeter



Consequences:

- Time loose: 2.5 hours and more than 200 children to evacuate
- H₂ loose: 300 kg
- Financial impact: millions of \$



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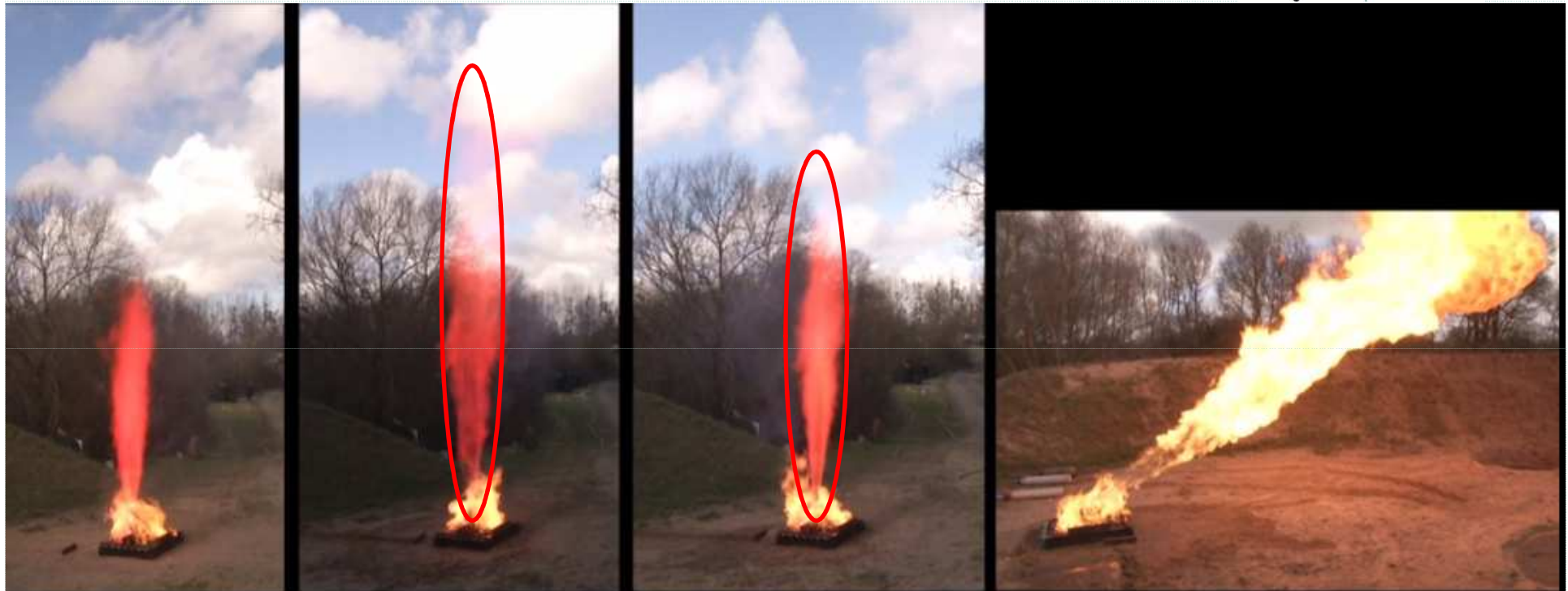
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What we already know



Comparison between H2, CH4, LPG



H2 200 bar
60 l

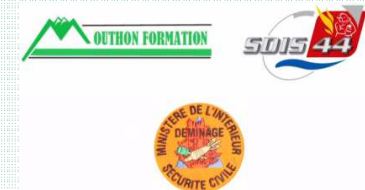
CH4 200 bar
60 l

H2 350 bar
20 l

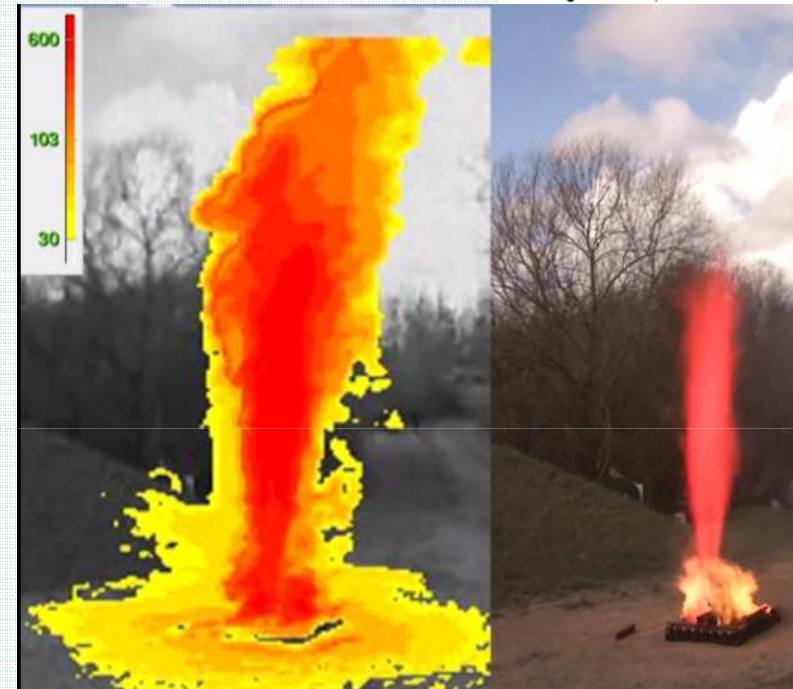
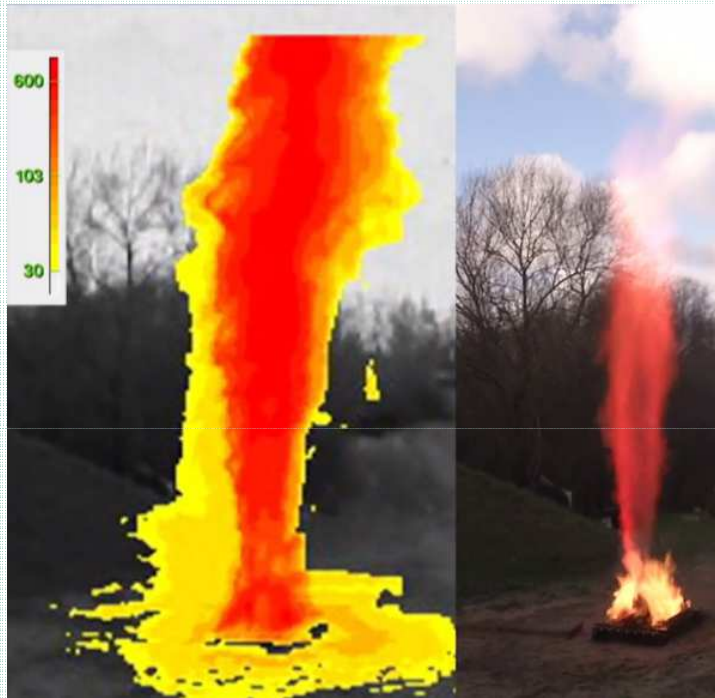
LPG
57 l



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Comparison between H₂ and CH₄



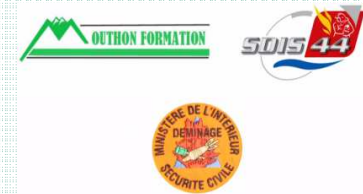
- In same volume at same pressure there is 8 times more CH₄, than H₂
- The methane flame has radiation effects twice as large as the H₂ flame



Comparison between H₂, CH₄



At high pressure, when the source of ignition stops, CH₄ stops burning



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The end



Comparison between H2, CH4



	H2	CH4		
MM	2	16	16	units
P	350	350	350	bar
d	1	1	0,6	mm
M	17	47	17	g/sec

LHV	120	50	50	MJ/kg
P	2,04	2,35	0,85	MW
Xrad	0,08	0,15	0,15	-

Prad	0,1632	0,3525	0,1275	MW
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