

Examples of national and local network building around FCEV and HRS roll out in the EU

Marieke Reijalt
EHA Office Brussels

Hydrogen Days, April 2-4, 2014 Prague



... in the last 24 hours

April 7-10, 2014: Hannover Fuel Cell and Hydrogen Group Exhibit has largest number of exhibitors.

April 1, 2014: EU Parliament Transport Committee approves Alternative Fuel Infrastructure Directive: first article on hydrogen

March 2014: four National Implementation Plans for hydrogen station development along TEN T corridors presented

March 2013: Aberdeen becomes 10th city in Europe to operate fuel cell buses on regular bus routes



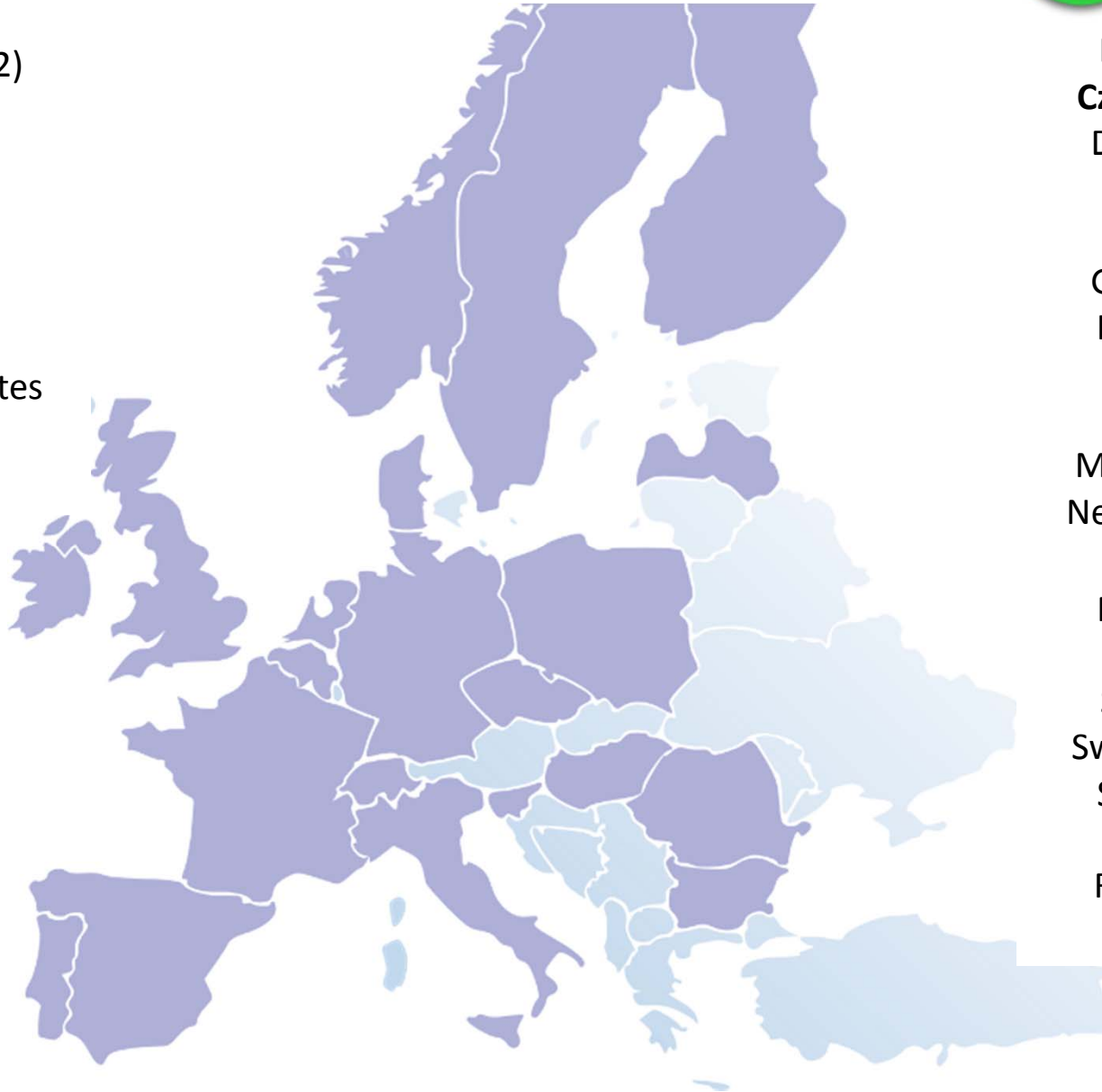
EHA National FC H2 Associations



2006 (6) > 2014 (22)

EHA's 21 national
associations are
representing:

300 SME
100 research institutes
and universities
36 regions



Bulgaria
Czech Rep.
Denmark
Finland
France
Germany
Hungary
Italy
Latvia
Macedonia
Netherlands
Norway
Portugal
Spain
Sweden
Switzerland
Slovenia
Ireland
Romania
U.K.

EHA FCH JU Project Dissemination Support



2009

FC-HyGuide

Guidance Document for LCA studies on hydrogen production and fuel cell technologies

SHEL and HyLIFT-DEMO

Demonstration of Fuel Cell and Hydrogen forklift trucks

HyPROFESSIONALS

Training initiatives for technical professionals

HyFACTS

Training material for Regulators and Public Safety Officials.

2010-2011

Don Quichote:

Renewable hydrogen / PEM electrolyser production to power forklift trucks in logistic of supermarket chain

HyLift Europe:

Large scale roll out fuel cell forklift trucks

HyResponse

Online training material for emergency response services

H2Trust assess industry efforts to assure FCH technology is safe

2012 - 2014

Alkammonia

Alkaline fuel cell and ammonia reformer development for remote power

Power up

Alkaline fuel cell power system linked to chlor alkali plants

H2Trust assess industry efforts to ensure FCH technology is safe

HyER Regional Network



2008 (9) < 2014 (40)

Population: 120 mln

GDP: 400 bln

Public and light-duty
transport key areas
of concern

HyER

European Electromobility Observatory EEO



EEO was set up in 2012 with the support of HyER member regions and EC;

EEO focuses on battery electric and fuel cell electric vehicles and infrastructure

EEO 's role is mentioned in EU Clean Power for Transport communication:

“ ..facilitate information exchange and coordinated regional action across the EU ..”

EEO is designed to answer key questions on drives and support schemes as well as compile learning from best practices across Europe;

Identify robust deployment channels based on specific local conditions;

EEO to become a major tool to for policymakers at all levels:

- Monitoring infrastructure planning across Europe
- Analysing data and providing policy recommendations

EEO first annual report ready February 2014: **no data from Hungary...**



Fuel cell electric vehicle FCEV to date

January 2013

- Toyota & BMW to launch FCEV platform by 2020;
- Daimler, Ford & Renault-Nissan develop a common FC system for mass-market cars as of 2017;

February 2013

- Hyundai starts production ix35 FCEV: 1,000 units by 2015;

March 2013

- Hyundai, Honda, Toyota, Nissan, infrastructure companies and Nordic NGOs bring FCEV to Scandinavia from 2014

April 2013

- UK H2Mobility study: 1.6 million FCEV on UK roads by 2030

October 2013

- Toyota and Air Liquide partnership to build H2 stations

November 2013

- Toyota and Honda reveal commercial models at Tokyo Motor Show

January 2014:

- Detroit Motor Show: Toyota presents commercial FCEV, calls Renault view of FCEV “from the 90’s”



Building local FCEV hubs

CUTE/ECTOS: 2001 – 2005

- Demonstration of a fleet of 30 fuel cell buses in regular public transport: first local FC bus networks created, Reykyavik



HyFLEET:CUTE: 2006-2009

- 47 fuel cell powered buses in public transport
- Local support networks in 10 European cities
- 2.600.000 km* in public service, 555 tons* of H2 refuelled and more than 1 million liters of diesel replaced
- Fuel cell buses are suitable for operation in public transport
- Development of a new, fuel efficient fuel cell hybrid bus concept



CHIC – High VLO-City 2010 – 2014

- 31 FC hybride buses in 7 cities
 - Ambition: 85% bus availability , 98% availibilty H2 stations (current)
- * figures include CUTE and ECTOS fuel cell bus operation



FC Bus deployment in the last five years*

| date | Partner | fleet |
|------|------------------------|-------------------------------|
| 2013 | Bolzano London | 5 buses 3 buses |
| 2012 | Milan Oslo Aarau | 3 buses 5 buses 5 buses |
| 2011 | Davis (US) | 22 buses |
| 2011 | Hamburg Cologne | 4 buses 2 buses |
| 2010 | London | 5 buses |
| 2009 | Whistler | 20 buses |

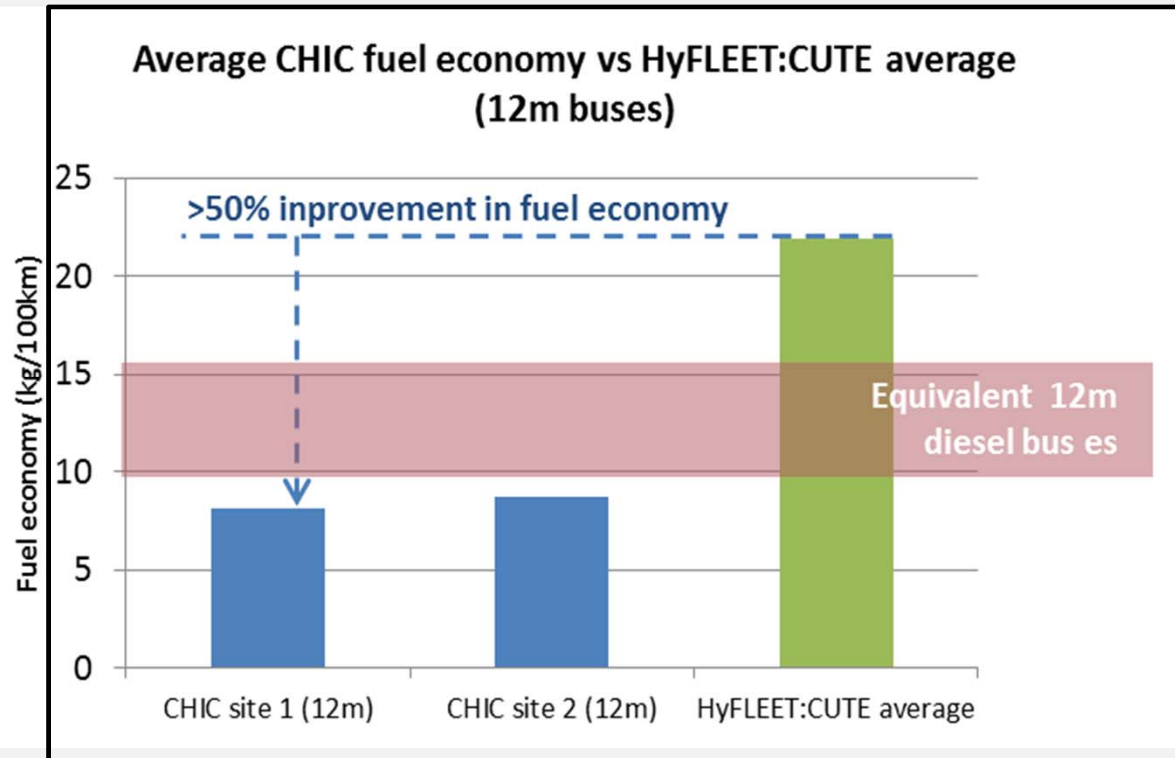


* Additional to existing buses



Dramatic FC Bus fuel economy improvements

- One of the most significant results is the improvement in fuel economy
- The chart compares the fuel economy observed in the CHIC cities using 12m buses with the average from HyFLEET:CUTE and some benchmark diesel vehicles.
- The reason for the >50% improvement is the use of fully hybridized powertrain, smaller and more-optimized FC systems.



Key challenges

| Improvements | Future steps |
|--|--|
| Bus availability increased compared to previous projects | Availability needs to improve over 90% |
| Warranties of fuel cells on the vehicles have increased to 15,000 hours | Even longer warranties (35-40,000 hours) will be needed |
| | Expand the FC bus platform choice (e.g. 18 m or large capacity buses) |
| Prices of buses have fallen considerably during the CHIC project, lowest vehicles prices = €1.1 milliard | Prices need considerable further reduction to enable genuine market traction (< €500,000) |
| CHIC has demonstrated fuelling station designs which are appropriate for 10 buses/day | To service a full depot designs for 100 buses/day will be needed |
| Results from discussions with policy makers and opinion formers | Clear routes to affordable hydrogen from green sources to be demonstrated and well articulated |

EU Clean Power for Transport – Investment costs

“Avoided fuel use increases progressively over the decades 2010-2030 from about €610 million per year in 2020 to about €2.3 bn per year in 2030

under Policy Option 2, €1.7 bn per year in 2020 to €4.6 bn per year in 2030 under Policy Option 3, and €4.2 bn per year in 2020 to €9.3 bn per year in 2030 under Policy Option 4”.

Table 3: Estimated investments costs under each Policy Option²

| | Number of additional charging points/fuelling stations | Policy Option 2 | Policy Option 3 | Policy Option 4 |
|---|--|------------------|-----------------|-----------------|
| | <i>thousands</i> | <i>Million €</i> | | |
| Electricity | | | | |
| (Total) | 8,000 | 3,984 | 7,968 | 7,968 |
| of 90% private | 7,200 | 1,872 | 3,744 | 3,744 |
| of 10% publicly accessible | 800 | 2,112 | 4,224 | 4,224 |
| Hydrogen | 0.143 | - | - | 230 |
| LNG for vessels | 0.139 | 1,140 | 2,085 | 2,085 |
| LNG for trucks | 0.144 | - | - | 58 |
| CNG for vehicles | 0.654 | - | - | 164 |
| Estimated investment costs of infrastructure deployment | | 5,124 | 10,053 | 10,505 |
| Estimated retrofitting costs | | - | 45 – 50 | 90 – 100 |
| Estimated total investments costs | | 5,124 | 10,103 | 10,605 |

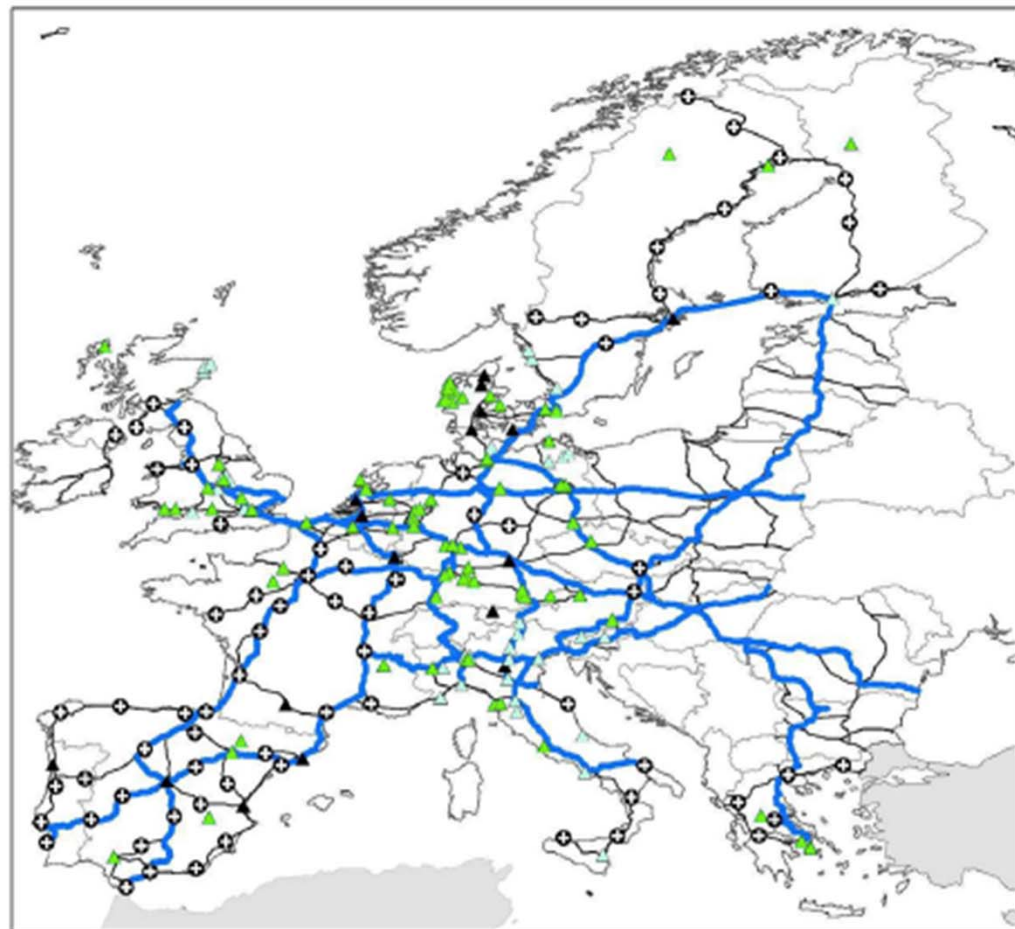
Clean Power for Transport: Council 5/12/2013, EP Transport 1/4/2014

Under the general approach, each member state will adopt a national policy framework for the market development of alternative fuels infrastructure. The frameworks will include, inter alia:

- an evaluation of the current state and future development of infrastructure
- national targets for putting in place new infrastructure
- deployment measures, including the yearly budget allocated to infrastructure deployment and to supporting manufacturing plants for alternative fuels technologies.

Both EU Parliament and Council are moved targets from 2020 to 2030

EU Clean Power for Transport: HRS 2020



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- ▲ H2 station in operation
- ▲ H2 station planned
- ▲ H2 station out of operation
- Filling stations
- Air stations
- Road corridors on the TEN-Core network
- Roads on the TEN-T Core network



JOINT RESEARCH CENTRE
Institute for Prospective Technological Studies (IPTS)



Clean Power for Transport

Two main causes for lack of alternative fuel infrastructure:

1. The technology is substantially mature but the standards are not common EU-wide, thereby discouraging potential infrastructure investors, car manufacturers and consumers
2. The co-ordination failure among vehicle manufactures, infrastructure providers, national authorities and final users must be addressed. Initiatives addressed at promoting infrastructure appear necessary to break this deadlock



Connecting Europe Facility

June 2013 : EC, EP and Council agreement:

EU priority infrastructure in transport, energy and digital broadband.

Budget €33.242 billion for the period 2014-2020:

€26.250 billion will be allocated to transport, out of which €11.305 billion ring-fenced for related transport infrastructures investments in the Member States eligible under the Cohesion Fund.

October 17, 2013:
Core network of 9 corridors was presented



National/regional infrastructure networks



Current H2 mobility activities managed by national public private partnerships in Germany, Scandinavia, UK , France, Switzerland, Netherlands:

US H2 Mobility April 2013: HRS roll out of first 68 stations to supply 1.5 million ZEV on Californian roads by 2025 and 68 Hydrogen Refueling Stations by 2015 ;

Japan November, 2013: 40 H2 stations in operation in Japan. Plans to open 100 stations by 2015.

December 2013: TEN T HIT 2 expanding H2 station network around the Baltic Sea, through Poland, Denmark, Netherlands to France, UK and Germany

First EU TEN T Hydrogen Corridor

- Facilitated by EHA and HyER in 2012:

Started with workshops with car OEM, H2 station suppliers and national and regional authorities.

Netherlands (no previous political interest!) became coordinator and ministries of France, Sweden and Denmark signed off after coordinated lobby efforts.

- Synchronizing National Implementation Plans (NIP)
- Infrastructure en fleet planning in regions
- Regulatory harmonization proposals
- Policy measures and & financial support schemes
- Strategy focusing on market development and scaling up from local initiatives to EU implementation



Co-financed by the European Union
Trans-European Transport Network (TEN-T)



Denmark: development of a national H₂ platform

Several private & public initiatives already – synchronization planned during 2014
Previously FCH area and in particular planning mainly private driven with public funding
As technology is preparing for market public side to become more involved in planning



HYDROGEN AND FUEL CELLS THE DANISH PARTNERSHIP

- *National fuel cells & hydrogen association*
- *30 members (industry + universities)*
- *Public programs are observersk*
- **Formulates R&D strategies & roadmaps**



Hydrogen Link



Scandinavian Hydrogen
Highway Partnership

- *DK Scandinavian Hydrogen transport network*
- **Formulates roll-out plans & roadmaps**
- **Handles Nordic MoU with car manufacturers**



Ministry of Transport



DANISH MINISTRY OF
CLIMATE, ENERGY AND BUILDING



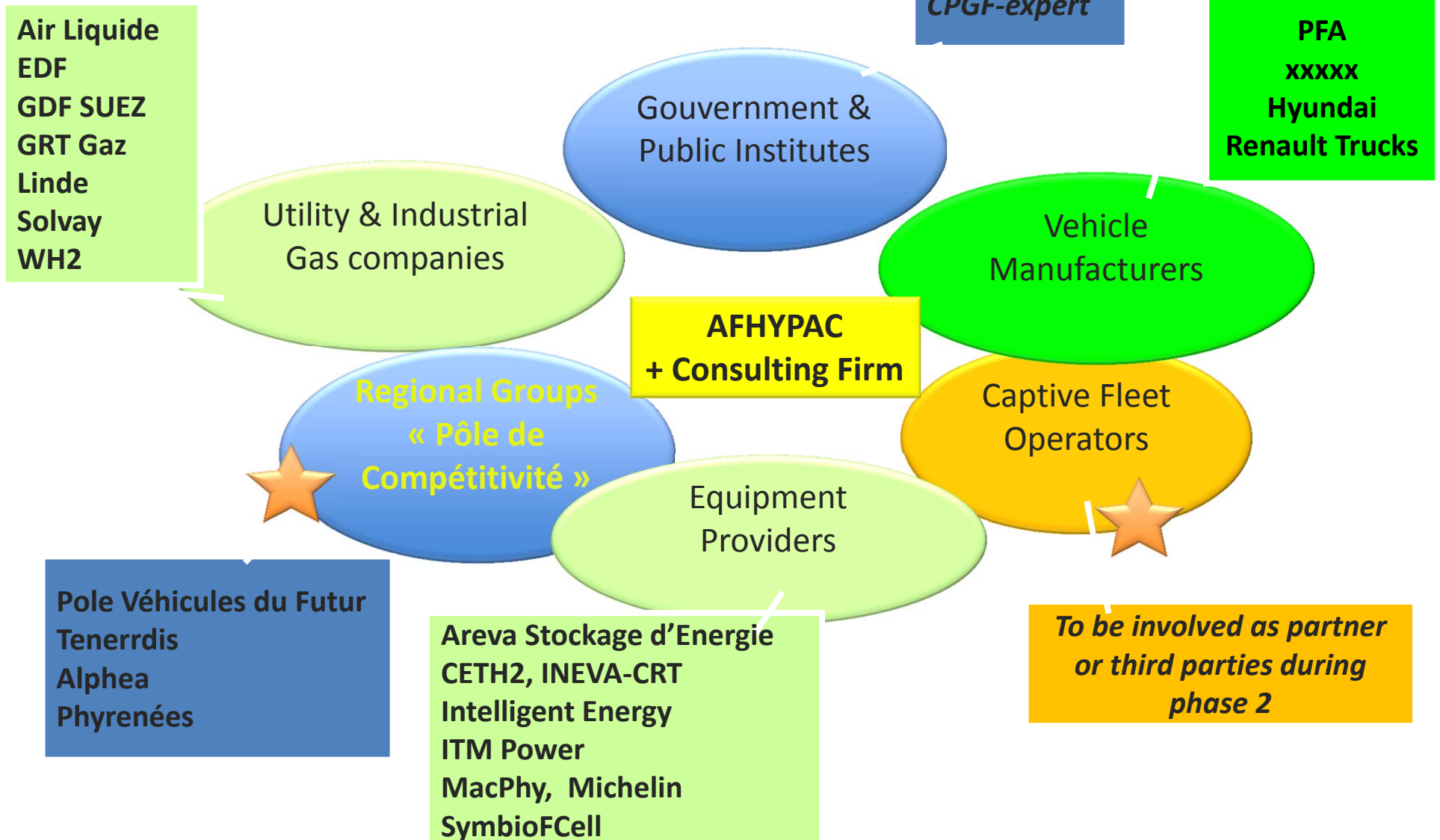
Danish Transport Authority



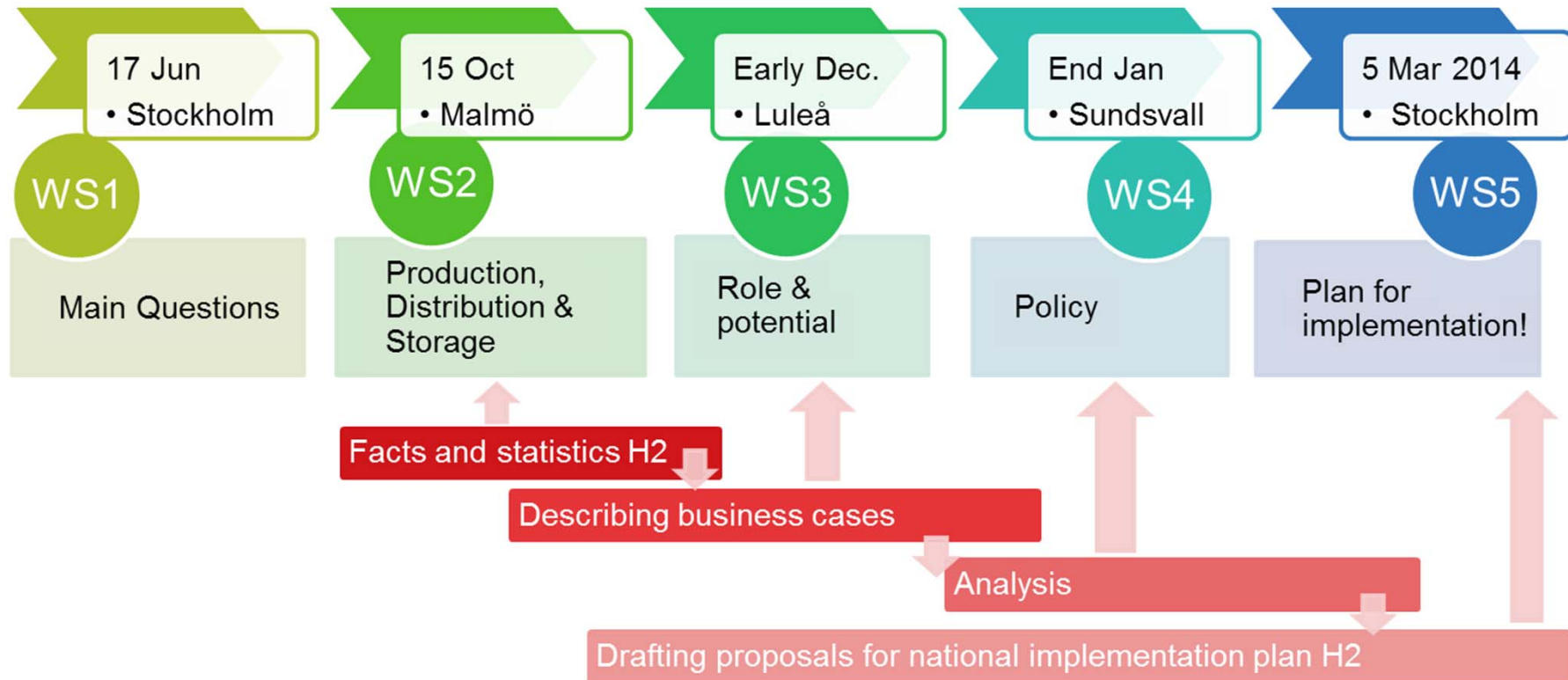
DANISH
ENERGY
AGENCY

- ***Infra program for BEV, Gas & Hydrogen***
- *“Partnerships” to be established for sectors*
- ***Public funding for analyses & infrastructure***
- *The results are to guide future public efforts*
- *Private initiatives to apply for “partnerships”*
- *Plan to apply for “H2 partnership” in 2014*
- *Existing analysis & HRS efforts to act as basis*
- ***Apply for additional HRS's for country network***

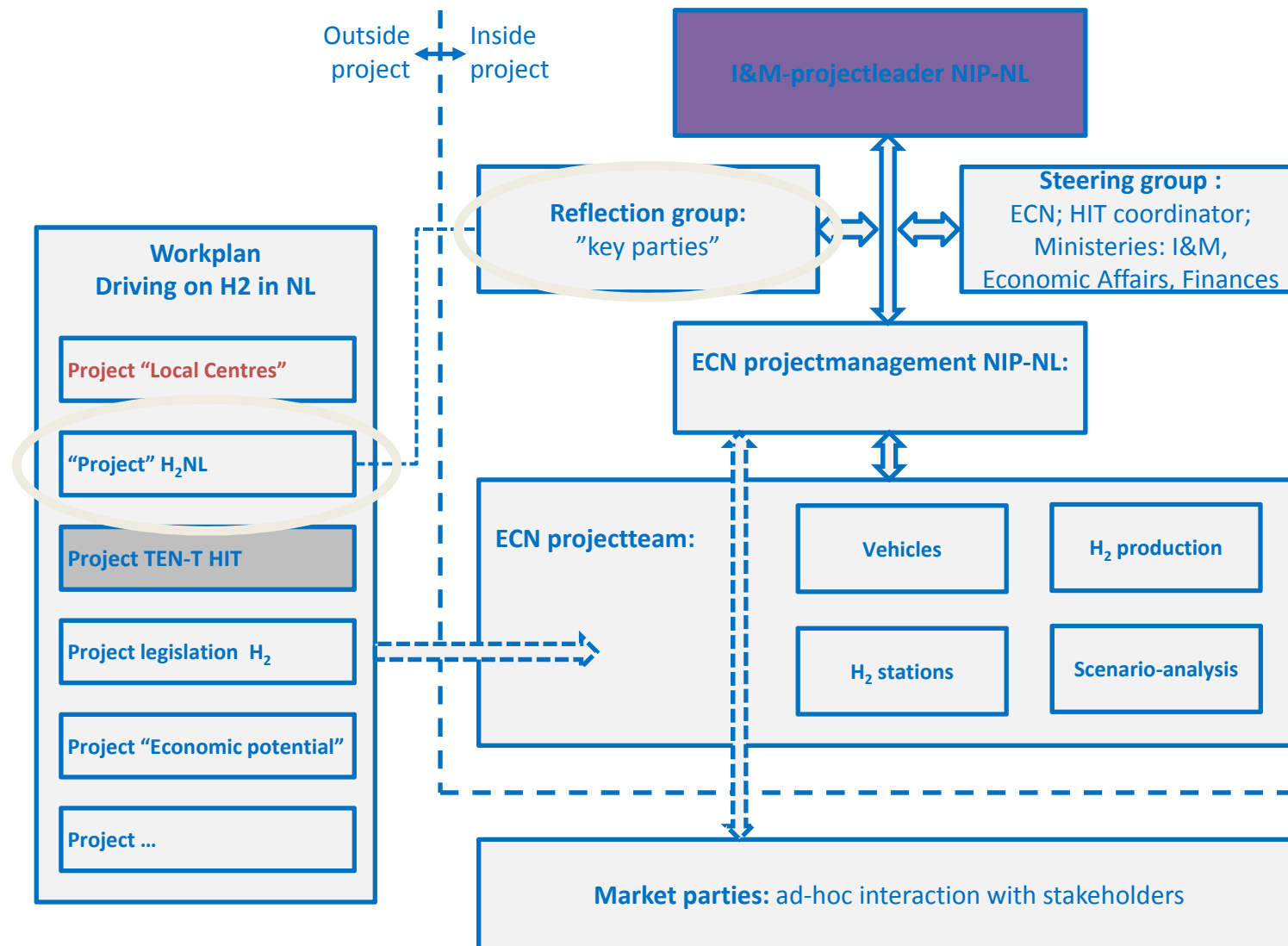
MOBILITE HYDROGENE FRANCE CONSORTIUM SEPT 2013



Sweden: NIP planning for HIT



NIP-NL Organisation



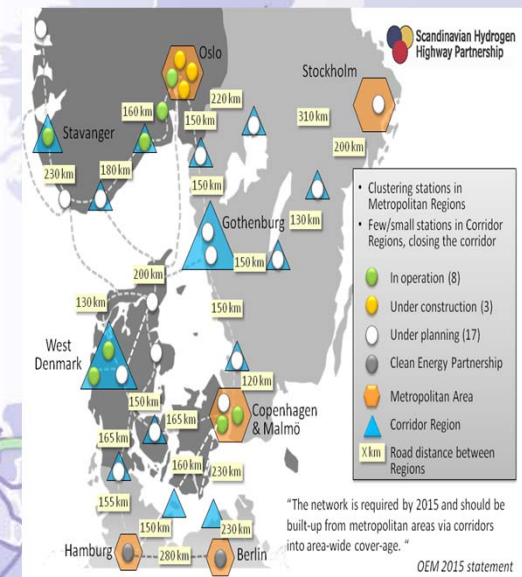
Synchronising 4 NIP's into 1 SIP

What?

- Comparative analysis NIP's
- Infrastructure en fleet planning
- Chosen H2 production & distribution pathways
- Recommendations on linking to TEN-T corridors
- Safety policies and implementation guidelines
- Regulatory harmonization proposals
- Policy measures and & financial support schemes
- An overall strategy, focusing on market development and scaling up from local initiatives to EU implementation

Who?

- A consortium of Sweco/ECN/LBST (result from international public procuremen: SE, NL, DE)
- Started 1/10/2013



Challenges for H₂ deployment



Challenges

1. Achieving HRS's & FCEV's within the same time interval
2. National & International harmonisation of HRS permitting procedures
3. Linking successfully to the EC's Clean Power Directive
4. Achieving commitment national and regional policy makers
5. To get early markets started
6. Realising cross-border traffic with FCEV's

Options to meet the challenges



- Ad 1. Well tuning and timing of different EC & national programmes to each other:
 - no infra call without a simultaneous vehicles call;
 - extra points in evaluation for linking infra & vehicles
- Ad 2. Start with national harmonisation
- Ad 3. LNG waterborne transport expected with binding targets, so:
 - Use the various options to integrate waterborne LNG infrastructure and NG + H2 for road transport*
 - Use the green options for bio-gas H2 production and the conversion from LNG to H2 (CCS with liquid CO2)*
- Ad 4. Link local/regional initiatives/ successes to national policy development
- Ad 5. Focus on local/regional markets first
- Ad 6. Focus on cross-border projects needed. Requires:
 - synchronizing Infra & Vehicle calls;
 - focus on local/regional governments



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Ideas for HIT sucesor projects (HIT2, HIT3)



- Option 1. A small scale HIT2 project focusing on linking NW Europe to South (and Eastern) Europe: short time frame
- Requesting:
 1. Project suggestions (Belgian corridor?)
 2. Focus on study, not on establishing infra
- Option 2: the GSG has a serious interest to engage in a large scale HIT 3 project
Requesting:
 1. Preparation period of at least a year
 2. Better insight in options and conditions for TEN-T projects
 3. Working out a proposal with advice from TEN-T EA
- Question: -how to synchronize a next H₂ infra project with calls in other EC programmes that can provide FCEV's?



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Linking Eastern Europe



1. February 19, 2014 Budapest Hydrogen Workshop:
2. - Joint Eastern Europe FCH Centre of Excellence
3. - Cooperation on FC Bus deployment SOR, EVEPRO, SKODA
4. - Submit topic to FCH JU Workprogramme through representatives in State Representatives Group

5.

6.



Join us!



Hannover Fair April 8-12

**EHA Secretariat
Square de Meeus 11000 Brussels**

+32 2 7632561

info@h2euro.org www.h2euro.org

1.

2.

3.

