

CHIC

Clean Hydrogen in European Cities

(256848)

FCH JU Programme Review Day 2012

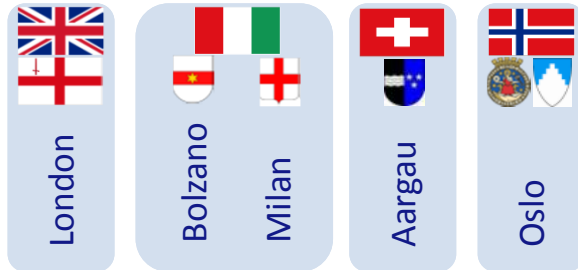
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Daimler Buses - EvoBus GmbH



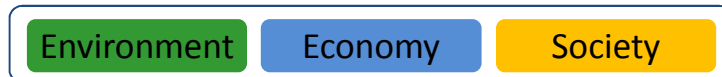
0. Project and partnership description

The CHIC concept

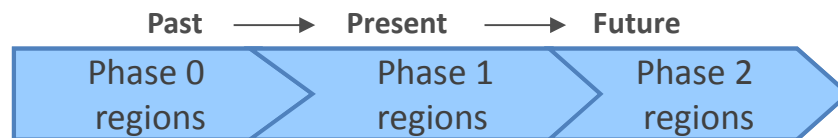
H₂ Infrastructure and FCH Bus



Assessment



Dissemination



CHIC in brief

- **25 partners** from **9 countries** worldwide (10 transport companies, 8 industry partners and 7 research/consultants)
- **26 fuel cell buses** operated in 5 Phase 1 cities; together with the Phase 0 cities more than **55 buses in operation**
- **3 different bus manufacturers** in the Phase 1 cities
- **2 filling stations per Phase 1 city** (one existing, one new station)
- Demonstration phase **2010 - 2016**
- **25.88 Mio. EUR funding**, 81.89 Mio EUR costs

1. Project achievements

General goals of CHIC



- **The CHIC project will:** implement clean urban mobility in 5 major European regions through the deployment of 26 hydrogen FC powered buses in medium sized fleets, and the enlargement of the hydrogen infrastructure systems
- **The CHIC project will:** facilitate the development of clean urban public transport systems and mobility action plans into 14 new European regions
- **The CHIC project will:** actively collaborate, transfer and secure significant key learning from previous FC projects into the CHIC stakeholders, thereby greatly accelerating the achievement of JTI and EC objectives
- **The CHIC project will:** deliver greater community understanding of 'green' hydrogen powered FC buses, leading to increased political acceptance and commitment

1. Project achievements

Technical goals of CHIC

Hydrogen Infrastructure Goals

- Hydrogen fueling station capacity of 200 kg/day
- Average availability of fueling station 98% (based on operation time)
- Production efficiency for H₂ between 50 and 70%
- H₂ OPEX costs less than 10 EUR/kg

Fuel Cell Bus Goals

- Fuel cell lifetime greater than 6000 h
- Average availability of all fuel cell buses greater than 85%
- Average fuel consumption less than 13 kg/100 km (dep. on drive cycle)

1. Project achievements

Status of bus operation

	City	No. of buses	Manu- facturer	Status of buses	Start of operation	km travelled (September 2012)
Phase 0	Cologne	2	APTS	In service	September 2011	31.296
	Hamburg	7	EvoBus	4 buses in service	August 2011	39.985
	Whistler	20	NewFlyer	In service	January 2010	2.552.206
Phase 1	Aargau	5	EvoBus	In service	December 2011	116.521
	Bolzano*	5	EvoBus	Contract signed October 2012	Regular Operation End 2013	n/a
	London**	8	Wrightbus	First 5 in service, final 3 del. in Dec 12	January 2011	198.038
	Milan	3	EvoBus	Delivery: Dec. 2011 - Feb. 2012	Filling station not yet completed	n/a
	Oslo	5	VanHool	Delivery: May 2012	Test operation since June 2012; regular operation end 2012	24.954

* Delay due to changes in national tender law and internal budget discussions which caused a republishment of the tender end of March 2012.

**Delay of final 3 buses due to a change of the vehicle and maintenance supplier.

1. Project achievements

Status of infrastructure operation of hydrogen refueling stations of Phase 1 cities

	Phase 1 City	Source of hydrogen	Supplier	Status of station	Start of operation
1st (existing) station	Aargau	Not required	n/a	n/a	
	Bolzano	Delivered gaseous	Sapio (IT)	In operation (not for FC buses)	
	London	Delivered liquid	Air Products	In operation	
	Milan	Onsite reformer	Sol (IT)	Currently not operative	
	Oslo	Delivered gaseous	Statoil	In operation (not for FC buses)	
2nd station	Aargau	Onsite electrolyser + trailer delivery	Carbagas (Air Liquide)	In operation	December 2011
	Bolzano*	Onsite electrolyser	tbd	1st tender closed 10/08/2012 with one invalid bid. 2nd tender opened in Sept. 2012, submission date 26.10.2012. Contract awarding Nov./ signing contract Dec. 2012	End 2013
	London	High pressure tube trailer	Air Products	Delivery of the HP-tubes by end of 2012. Trailer integration in Q1/2013. Principal system being redesigned to fulfill EN12245-2009 for composite storage systems, in effect from 2013.	April 2013
	Milan	Onsite electrolyser	Linde	Procured; construction started in February 2012	End 2012
	Oslo	Onsite electrolyser	Air Liquide	In operation	May 2012

* 2nd refuelling station not financed through CHIC budget

1. Project achievements

First experiences in Phase 0 cities

Phase 0 Cities

•Cologne

- Demonstration drive from Cologne to Stuttgart and back (range more than 1000 km) with intermediate filling in Frankfurt

•Hamburg

- Largest public refuelling station for hydrogen in operation since February 2012 (HafenCity, max 700 kg/d)
- Average consumption of hydrogen 8kg/100 km



•Whistler

- Currently BC Transit is doing a „Mid-Point Evaluation“ of the performance of the fleet
- Results will be used in developing the optimum „moving forward“ strategy for the fleet
- The demonstration project started 2010 and ends in March 2014

1. Project achievements

First experiences in Phase 1 cities

Phase 1 Cities

- Aargau
 - All 5 FC buses in daily service, passengers very interested in fuel cells technology
 - Special use as shuttle bus at Expo Bern, Film festival Locarno, ENERGIE St. Gallen
 - Successful test drive in Davos at 1560m NN to test air density
- Bolzano
 - Regular operation is planned to start end 2013
 - Buses will be operated in 2 shifts x 7 hrs x 310 days x 3 years to regain lost time and to reach the goal of 12.000 operation hours
- London
 - The refuelling station is fully operational
 - Temporarily closing of station during the Olympic Games due to security restrictions surrounding the Olympic park, re-opening early September
- Milan
 - Buses are ready and will start operation after completion of filling station end of 2012
- Oslo
 - Buses are in test operation since June 2012

1. Project achievements

Sustainability Assessment

- **Performance assessment**
 - Monitoring of operation of H₂ infrastructure and H₂ buses
 - Monthly reports of bus performance (i.e. operation hours, distance) and H₂ refueling
- **Environmental assessment**
 - Environmental profile of the system
 - Land use and related impacts of fuel production
- **Economic assessment**
 - Overview on the real costs of bus depots built-up within the scope of the CHIC project
- **Social acceptance**
 - Conducting > 85 interviews with citizens, bus drivers, technicians, operators, manufacturers, politicians and regional partners
 - Listening to skeptics and critics (50 people within a broad range of influential roles in 9 countries)
 - CHIC Round Table to facilitate open discussion between H₂ transport advocates and critics who see obstacles to development (Oct. 2012)

1. Project achievements

Dissemination to Phase 2 cities

- **Presentations** at over 20 national and international events during last year, i.e.
 - UITP Bus Committee
 - World Hydrogen Energy Conference
- More than 25 cities on the **list of interested cities** (so called Phase 2 cities):
 - Increasing number of interested cities through meetings with metropolitan regions in different countries
- **Workshops and meetings** with interested regions and cities, i.e in Italy, France, Slovenia, Hungary and Spain
- Second **Phase 2 workshop** in San Remo on March 25, 2012 on the occasion of the FCH JU High VLO-City
- **CHIC Phase 2 Guidance document** for interested parties

2. Alignment to MAIP/AIP

Alignment to technical targets AIP 2009

Technical targets AIP (call 2009)	CHIC targets
<p>Infrastructure:</p> <ul style="list-style-type: none"> • Capacity of 200 kg/day, upgradable to 100 vehicles per day • Availability of station 98% • OPEX < 10EUR/kg (excl. tax) • Hydrogen purity and vehicle refueling time (according to SAE or analogous specification) • Production efficiency target 50-70% 	<p>Infrastructure:</p> <ul style="list-style-type: none"> ✓ Capacity of 200 kg/day, upgradable to 100 vehicles per day ✓ Availability of station of 98% ✓ OPEX < 10EUR/kg (excl. tax) ✓ Hydrogen purity analogous SAE spec, bus refueling time not defined in SAE ✓ Production efficiency between 50-70% ❖ Replacement of 500.000 l diesel fuel
<p>Buses:</p> <ul style="list-style-type: none"> • >4000h lifetime initially, min 6000 hrs lifetime as program target • Availability >85% with maintenance as for conventional buses • Fuel consumption < 11-13 kg/100km depending on drivecycle 	<p>Buses:</p> <ul style="list-style-type: none"> ✓ Fuel cell lifetime > 6000 hrs ✓ Average availability of fuel cell buses > 85% ✓ Average fuel consumption < 13 kg/100km (depending on drive cycle) ❖ Minimum running distance of 2,75 Mio km of fleet ❖ Minimum of 160.000 hrs of operation of fleet

2. Alignment to MAIP/AIP

Alignment to technical targets AIP 2009

Project Goals (as per DOW)*		Phase 0 Cities				Phase 1 Cities		
		Berlin	Cologne	Hamburg	Whistler	Aargau	London	Oslo
FC lifetime per bus [h]	> 6.000	N/A	N/A	564	N/A	1.106	3.873	N/A
availability based on operation time [%]	> 85	N/A	N/A	N/A	N/A	N/A	N/A	N/A
fuel consumption [kg/100 km]	< 13	23,5	N/A	8	14,5	N/A	8,5	N/A
Project total running distance [Mio. km]	> 2,75	0,703	0,031	0,4	2,55	0,12	0,2	0,025
Project total hours of operation [h]	> 160.000	N/A	N/A	2.254	N/A	5.528	15.491	N/A

Current data of the Fuel Cell Buses in the CHIC project – September 2012

2. Alignment to MAIP/AIP

Alignment to technical targets AIP 2009

- Current data of the Fuel Cell Buses in the CHIC project not yet completed because some cities are still in their „Ramp-Up“-Phase
- Not all buses are in service:
 - * Bolzano → Delay in tender due to changes in national tender law and internal budget discussions.
Start of regular operation end of 2013
 - * London → Buses were out of operation due to security restrictions around the Olympic Park during the Olympic/Paralympic Games 2012
 - * Milan → Filing station not yet completed due to damage during electrolyser transport
Start of regular operation end of 2012
 - * Oslo → Buses are in test operation since June 2012. Start of regular operation end of 2012
- Not all cities have an automatic data exchange system. Activities for installation are in preparation. Aargau is implementing a new data collection scheme
- Whistler is reworking the data collection due to:
 - * uncompleted data collection
 - * schematical errors
 - * new data calculation
 - * manual data review

2. Alignment to MAIP/AIP

Alignment to the technical targets of MAIP
and potential improvements

Target 2012: 26 buses on 5 sites with appropriate refueling infrastructure

Target could not be reached due to various reasons:

- Delay of H₂ infrastructure in Milan
- Delay in tender Bolzano due to changes in national tender legislation

Target 2015: 500 buses at 10 EU sites (of which at least 7 new ones) with refueling stations (daily capacity > 400kg)

- CHIC has started 4 new bus sites (Aargau, Bolzano, Milan, Oslo)
- Further funding for the large demonstration projects with a demonstration start 2014/2015 is necessary to reach this target

3. Cross-cutting issues

Training and education

- Training of drivers and staff
- Information activities for the public
- Open days and events at the bus depots

Safety, Regulations, Codes and Standards

- Preparation of infrastructure and bus operation according to the regional law
- Exchange of safety requirements and actions between the partners
- Preoperational training of drivers, engineers and mechanics as well as the regional fire department
- Implementation of safety codes and codes of behavior in case of urgency

Dissemination and publications

- Internal Project Dissemination
- Publications of project achievements and experiences
- Global Project Level engaging EU and international projects
- Special Events: UITP Annual Conference, CIVITAS Annual Forum, EU Sustainable Energy Week, H2 & FC Fair, F-Cell Stuttgart

4. Enhancing cooperation and future perspectives

Contacts

- Regular teleconferences with all CHIC cities
- Regular visits of the CHIC dissemination team to CHIC cities
- Project updates enhanced: exchange and collection of relevant information and training material between partners
- Contacts with most relevant organisations of local authorities

Collaboration

- Organisation of an international workshop with International FC Bus Forum
- UITP Bus committee
- Collaboration with new JU FCH bus projects: *High VLO City and HyTransit*
- Joining of HyER (*CHIC partner*) to the Working Group 'Transport and Mobility' of the Smart Cities and Communities Initiative

4. Enhancing cooperation and future perspectives

Events & Conferences

- Visibility at EU energy and transport events
 - EP Seminar
 - SET Plan Conference
 - EU Future Fuels Group
 - European Smart Mobility Innovations Partnership
 - Hanover Fair 2012
 - EU Sustainable Energy Week 2011 and 2012
 - Launch FP 7 Call 2012
- Perspective: Collaboration with World Economic Forum Davos, 2013



4. *Enhancing cooperation and future perspectives*



Project Future Perspectives

- Due to the delay in the tender of the city of Bolzano the demonstration on route will be complete in end of 2013
- Practical experiences will help improving the technology and will give guidance to future fuel cell buses
- Collaborations with new JU FCH bus projects help drive the technology
- Intensified cooperation between national and EU funding programs
- CHIC Student Days for teachers and pupils