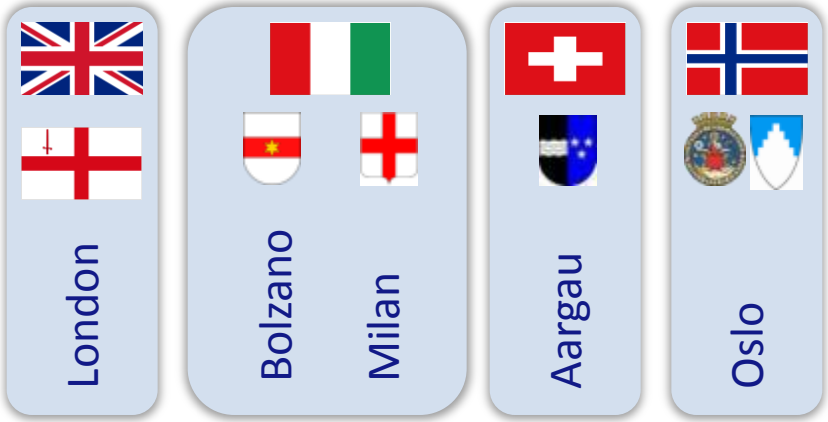
Clean Hydrogen in European Cities (256848)

Monika Kentzler
EvoBus GmbH

- **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

H2 Infrastructure and FCH Bus



Assessment

Environment | Economy | Society

Dissemination

- 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
- At least 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, 81.8 Mio EUR costs

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

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)

Sustainability assessment of the use of hydrogen powered buses in public transport

- **Performance assessment**
  - Monitoring of operation of H2 infrastructure and H2 buses
- **Environmental assessment**
  - Environmental profile of the system, incl. LCA
  - Land use and related impacts of fuel production
- **Economic assessment**
  - Development/ enhancement of life cycle cost model covering H2 infrastructure and vehicles
  - Target costing for benchmarking with other alternative buses
- **Social acceptance**
  - Investigating the causative drivers behind different attitudes and perceptions of hydrogen powered public transport buses

1. Project description and achievements status of bus procurement / operation

	City	No. of buses	Manu-facturer	Status of buses	Start of operation	km travelled (Aug. 31, 2011)
Phase 0	Cologne	2	APTS	in service	April 2011	8.065
	Hamburg	7	EvoBus	First 2 in service	August 2011	
	Whistler	20	NewFlyer	in service	January 2010	850.000
Phase 1	Aargau	5	EvoBus	Delivery: Oct. 2011	n/a	n/a
	Bolzano	5	Tbd	Tender to be re-published*	n/a	n/a
	London	8	Wrightbus	First 5 in service, final 3 del. in Dec 11	January 2011	57.400
	Milan	3	EvoBus	Delivery: Dec. 2011	n/a	n/a
	Oslo	5	VanHool	Delivery: March 2012	n/a	n/a

* due to internal budget discussions tender will most like only be re-published in Jan 2012

1. Project description and achievements status of infrastructure procurement / 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	n/a	In operation (not for FC buses)	
2nd station	Aargau	Onsite electrolyser + trailer delivery	Carbagas (Air Liquide)	Procured; building renovation started	April 2012
	Bolzano*	Onsite electrolyser	tbd	Tender to be published end Sept 2011; awarding end Dec 2011	End Dec 2012
	London	High pressure tube trailer	Air Products	Design ongoing	July 2012 (before the Olympics)
	Milan	Onsite electrolyser	Linde	Procured; construction to start Oct 2011	End May 2012
	Oslo	Onsite electrolyser	Air Liquide	Procured; construction to start in October; electrolyser delivery planned in Dec 2011	March 2012

* 2nd refuelling station not financed through CHIC budget

- More than 25 cities are on the list of interested cities (so called Phase 2 cities).
- A helpline has been created for cities that are interested in setting up new hydrogen bus projects.
- First workshop to take place October 25th 2011 Busworld Europe Exhibition in Kortijk, Belgium with interested city representatives.

CHIC Hydrogen Refuelling Infrastructure Help-line:
Infraserv GmbH & Co. Höchst KG
Tel. +49 69 305-17881

CHIC Fuel Cell Hydrogen Bus Help-line:
Element Energy
Tel. +44 (0) 330 119 0989 // +44 20 3195 8119

2. Alignment to MAIP/AIP
Alignment to technical targets AIP 2009

Technical targets AIP (call 2009)	CHIC targets
Infrastructure: • 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%	**Infrastructure**: ✓ Capacity of 200 kg/day, upgradeble 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
Buses: • >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	**Buses**: ✓ 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 the technical targets of MAIP and potential improvements

Target 2010: 20 buses on 3 sites with appropriate refueling infrastructure

Target could not be reached due to various reasons:

- Start of JU FCH slower than expected
- CHIC Grant Agreement only signed in November 2010

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 are necessary to reach this target
- Results of tendered commercialization study could update the figures

The dissemination and outreach is addressed by a separate work package, with two levels of dissemination:

1. General dissemination

- Internal Project Dissemination
- 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

2. Dissemination to Phase 2 cities to prepare for FCH powered bus integration in the near future

- Engagement of local and regional transport authorities
- Special Events: Busworld Europe, International Transport Forum

- Contacts to and collaborations with
  - Very good cooperation within the project partners
  - Visibility at EU energy and transport events (e.g. EP seminar, SET plan conference, EU future fuels group, European smart mobility innovations partnership)
  - Most relevant organizations of local authorities(e.g. CONCERTO, CIVITAS, Covenant of Mayors, ACEA, UITP)
  - International collaborations (e.g. *International Fuel Cell Bus Workshop (US, Canada, Japan, China), IPHE recognition application, Clinton foundation)*
  - Collaboration with new JU FCH bus projects

- Project Future Perspectives
  - Due to the late signing of the CHIC Grant Agreement most buses will be delivered late in 2011, so that the demonstration on route will only begin in early 2012. This will have no effect on the overall project goals though as the project runs until December 2016.
  - Commercialization study for fuel cell buses important for general future expectations of the technology
  - Intensified cooperation between national and EU funding programs