NextHyLights

Supporting Action to Prepare Large-Scale Hydrogen Vehicle Demonstration in Europe

WP6 Social and environmental impacts, regulatory requirements

Ingo Bunzeck, Bas van Bree, Rodrigo Rivera, Hein de Wilde (ECN)

Mid-term meeting 22 JUL 2010
Daimler AG, Kirchheim/Teck-Nabern

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Social impact assessment of large-scale hydrogen demonstration projects
- Interim results -

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- Aim of the task
  - Review the expected social impacts of the large-scale introduction of hydrogen in society
  - Provide a framework how social impacts could be positively stimulated, i.e. acceptance improved

- Why is social impact assessment of relevance?
  - Fundamental for the successful implementation of hydrogen
  - Public acceptance of hydrogen vehicles and refuelling stations
  - What societal barriers could hamper large-scale deployment?

- Worst case scenario – low public acceptance turns into public opposition
  - Example of CCS demo project in Barendrecht (Rotterdam, NL)
  - Feasibility studies conducted by Shell
  - Public wants ‘credible’ institutions they can trust – e.g. NGO’s

- Methodology
  - Largely based on literature review of existing studies
    - Ricci (2008), Midden, (2004), HySociety
  - Studies on demonstration project level
    - AcceptH2, ZeroRegio, HyFleet Cute, HyChain, HyTrust (NOW financed)
  - Synthesis of what are the issues that could play a role in refuelling station built-up and demonstration projects
  - NOT: Dedicated studies or surveys
    - PreparH2 project to study and monitor socio-economic issues such as acceptance in-depth (FCH JU), led by Icelandic New Energy

- Social or public acceptance is a wide-stretching topic
  - Can entail everything linked to the purchase and use of hydrogen in general or specific applications
  - Different studies (mainly surveys) address hydrogen applications, but do not incorporate a system perspective
  - Acceptance is a lack of (explicit) public opposition to the introduction of hydrogen (Ricci 2008)
- Social acceptance in NHL focuses on large-scale hydrogen demonstration projects in the transport sector
  - Meaning an increased number of vehicles on the road and more hydrogen fuelling stations to be built
  - If hydrogen meets good acceptance in large-scale demonstration projects, the chances of good acceptance in the (early) commercialization phase are also more favourable

- Results of the literature review
  - High level of acceptance and positive beliefs of hydrogen technologies
    - But lack of knowledge concerning hydrogen technologies
    - Real acceptance of hydrogen applications could be much lower
  - Level of support was especially high when conducted in connection to demo project and there was a possibility to try the application (e.g. HyFleet Cute)
  - Positive attitude is correlated with prior information about hydrogen (O'Garra)
  - People intuitively know that hydrogen is incredibly dangerous and explosive (Zimmer 2010) → How to moderate this situation?

- Understanding acceptance
  - Due to the low level of public experience with hydrogen the validity of the studies seems difficult to estimate public acceptance
  - Up to 40% of the respondents choose ‘Don’t know’ or ‘No opinion’
    - Lack of information
  - Predominantly focused on buses (HyFleet Cute)
    - Due to large trials in different cities, broader expose to the public
  - Surveys don’t explain the broader picture of hydrogen in the whole energy system

- Analysis of acceptance is broken down to three levels:
  - Global – existence of a general positive view on hydrogen
    - High acceptance, low risk profile
  - Local – opposition can still arise, depending on the context
    - Local risk perception
    - Experiences with earlier projects
    - Local policies
  - Marketplace – do people want to use the applications?
    - Performance of the car
    - Price of hydrogen

- Influence local acceptance:
  - Factual information or real life experiences?
  - Raise public awareness by providing factual information about hydrogen in the energy system, not only applications
    - Needs to be produced from renewable sources to achieve full benefits – hydrogen as storage medium for RES-E
  - Reassure to the public that they can trust the information providers – intermediaries are better suited than companies
    - Benefits
  - Further need to offer the opportunity to the public to scrutinise the technology through real applications
- First phase needs to be overcome, than it will go fine
  - Once trust is established, the later build-up is no problem anymore

Next steps

- Update report with more information from studies of recent demonstration projects
  - Input industry partners
- Send out report to review to partners by mid-august
- Finalization Deliverable D6.1. ‘Social impacts of large-scale hydrogen demonstration projects’ by 31.08.

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Environmental impact assessment

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- Agreed:
  - Use the Well-to-wheel (WtW) approach for emission estimations
  - Use CONCAWE JRC database
  - Estimate emissions ONLY for demonstration projects of special vehicles and light passenger vehicles (up to 2020)
  - Estimate emissions (incl. air quality) for demonstration and roll-out scenarios for Buses
- The model to be used for emission estimations is READY!
  - Further validation and refinement of outputs are expected in the coming months
  - The detailed model for “Bus emissions” will be tested first because of the higher complexity

Input and outputs: WtW emissions

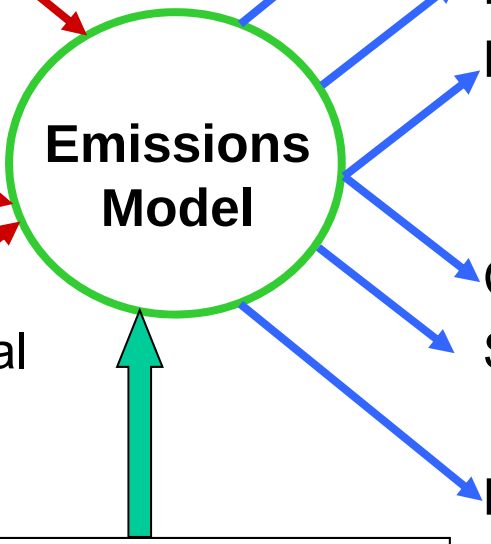
NEXTHYLIGHTS

FROM PARTNERS:

Market penetration rates HFCV
- Per country
- Per city

Hydrogen production pathways expressed in share. (e.g. 90% SMR, 10% Elec., 2015…)

On-site production share (% of total hydrogen production)



Emissions per country 2010-2050

Per country emission reductions

Per city emission reductions

Comparison with BaU emissions

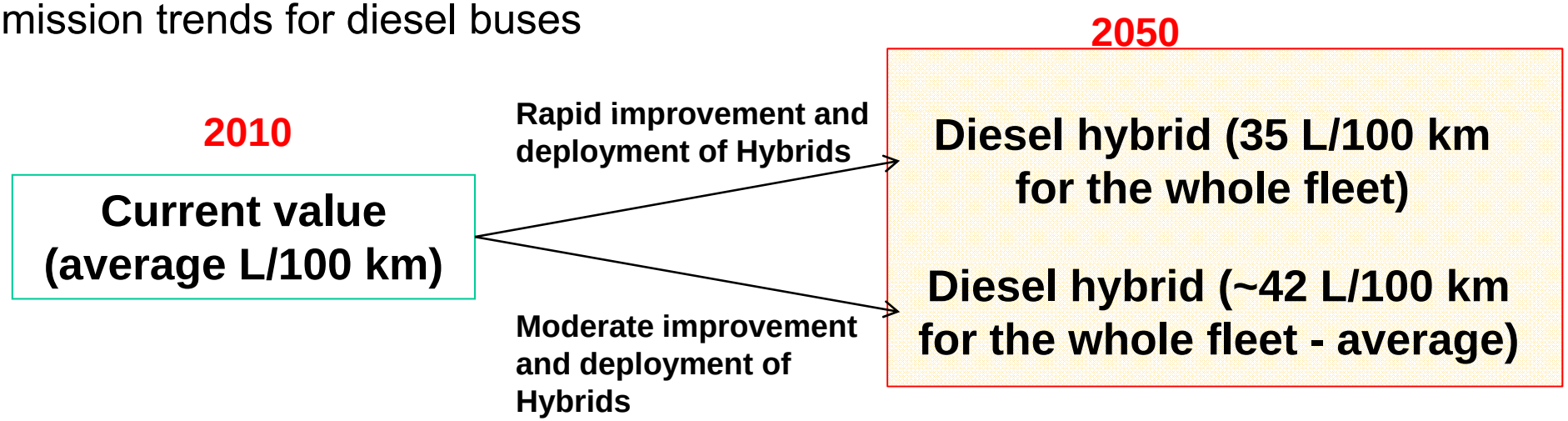
Sensitivity studies

Noise reduction (?)

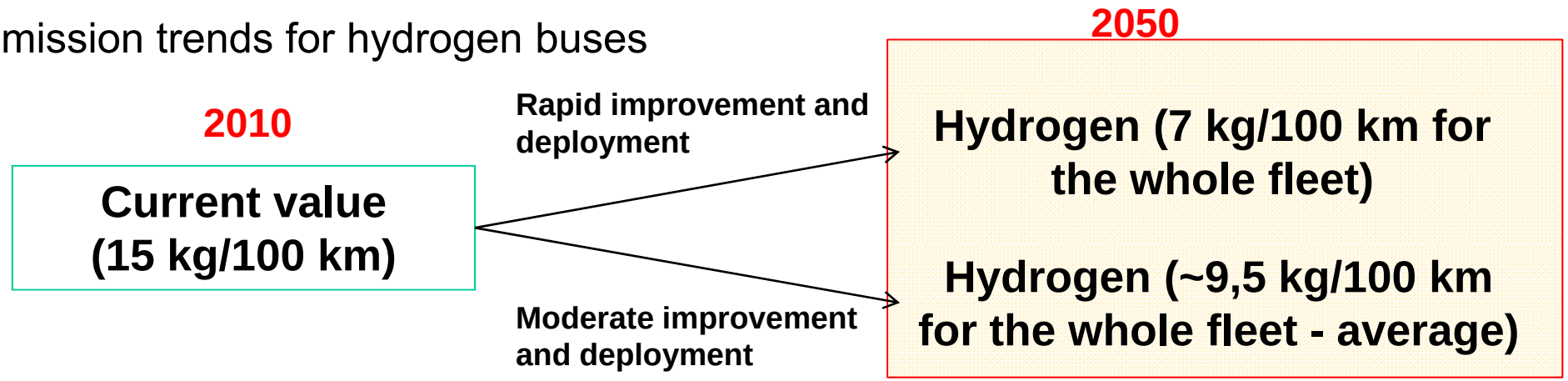
DATABASES:

CONCAWE, EUROSTAT, LCA documents

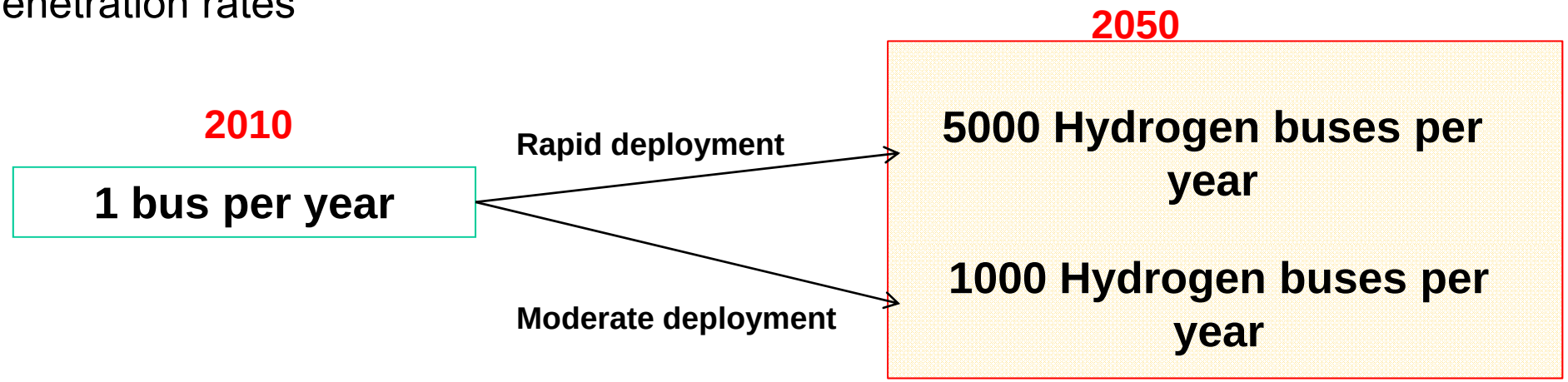
Emission trends for diesel buses



Emission trends for hydrogen buses

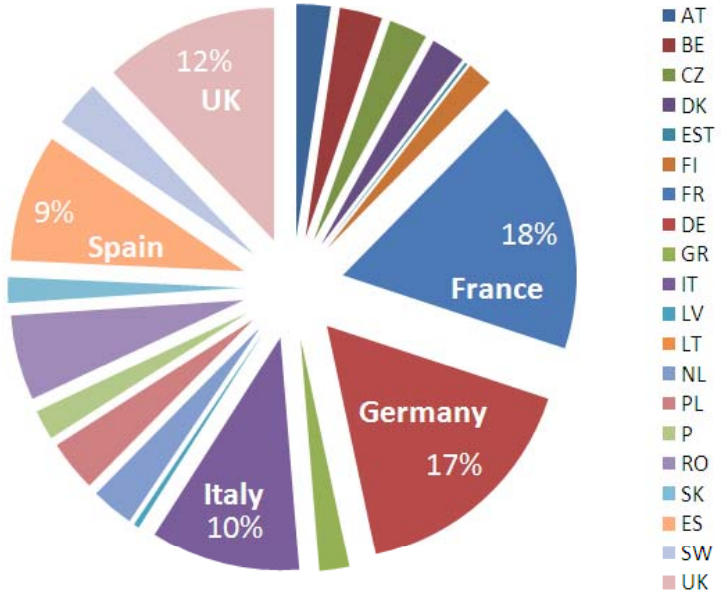


Penetration rates



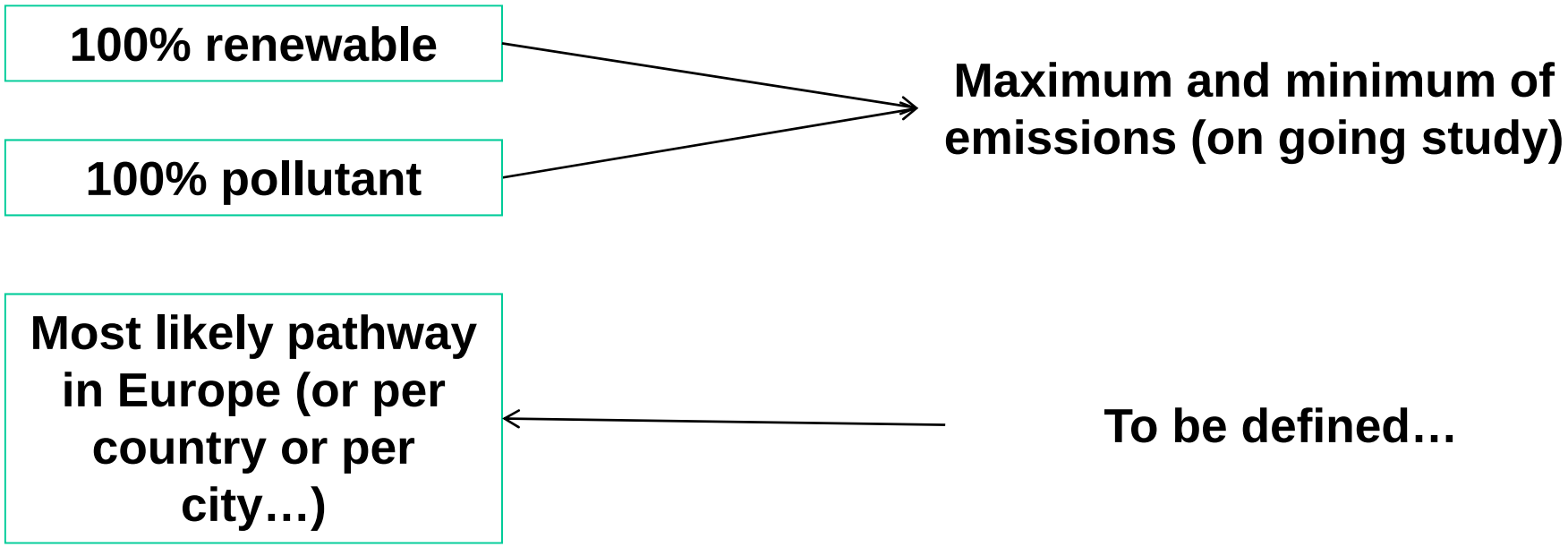
Market:

~ 34000 buses annually registered in Europe (2008,2009)



It seems that cities in the Hydrogen Bus Alliance (HBA) are renovating the fleet and replacing old buses for new ones: (ES) Barcelona, Madrid; (DE) Berlin, Cologne, Hamburg; (IT) Milan, Turin, South Tyrol; (UK) London,

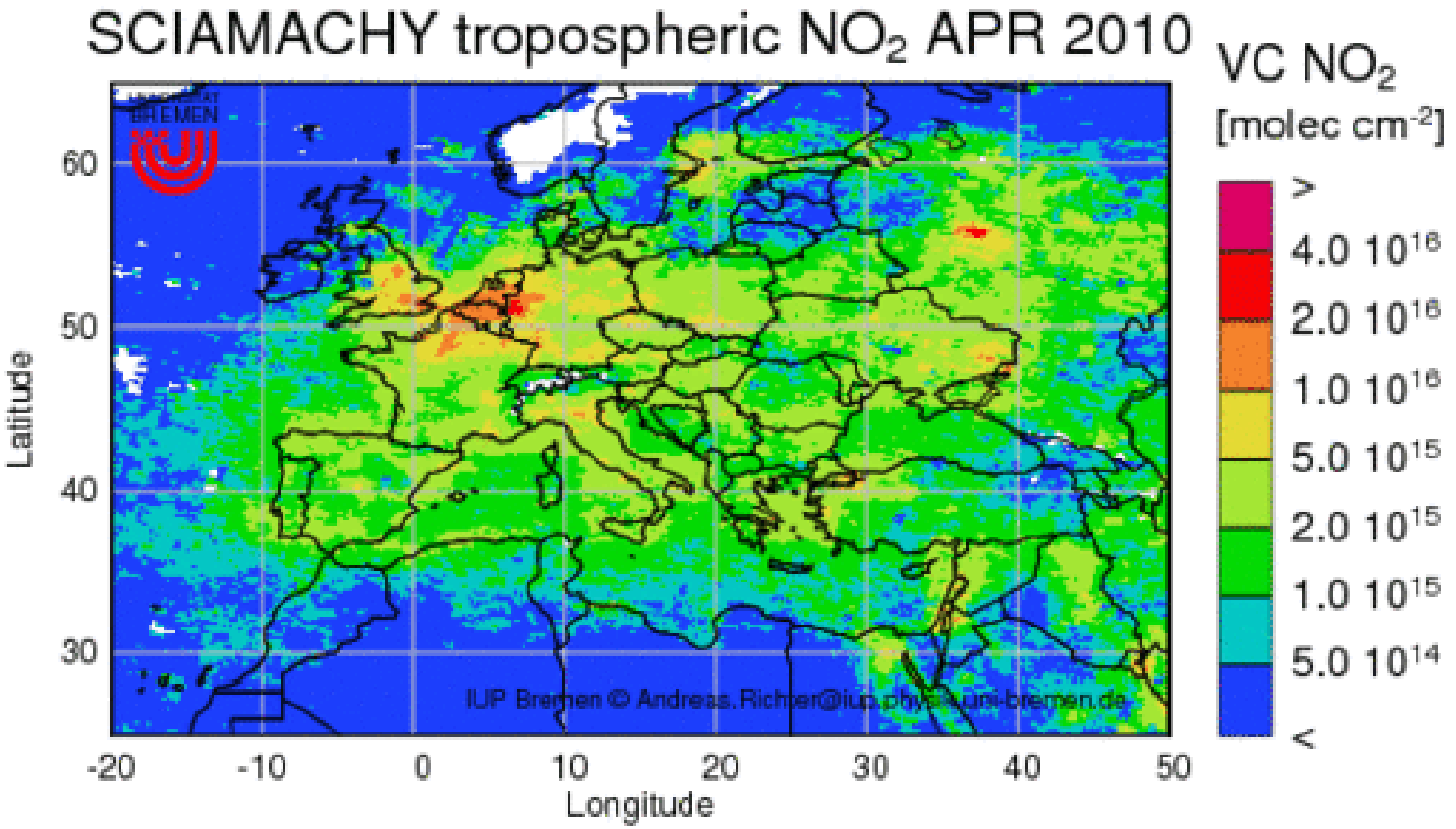
Hydrogen production pathways:



Background

- Air quality will remain a serious problem in European cities for the next decades.
- Conventional vehicles increasingly cleaner but no negligible PM and NOx source
- H2FCs buses have no direct air polluting emissions and meet the technical performance of diesel buses.
- Substituting diesel buses is most effective in city centers due to combination of dense population and limited dilution of exhaust gases

Road transport is largest contributor to NOx emissions in EU and the 2nd largest for PM10



source: http://www.iup.uni-bremen.de/doas/scia_data_browser.htm

Objective

- Assessment of air quality improvement by replacing current (2010) and future (2020-2030) diesel buses by H2FC buses in European cities.
- Focus on particulate matter/soot (PM10) and nitrogen oxides (NOx).
- A next step could be to express the improved air quality in terms of reduced morbidity and mortality, and to evaluate the cost effectiveness.

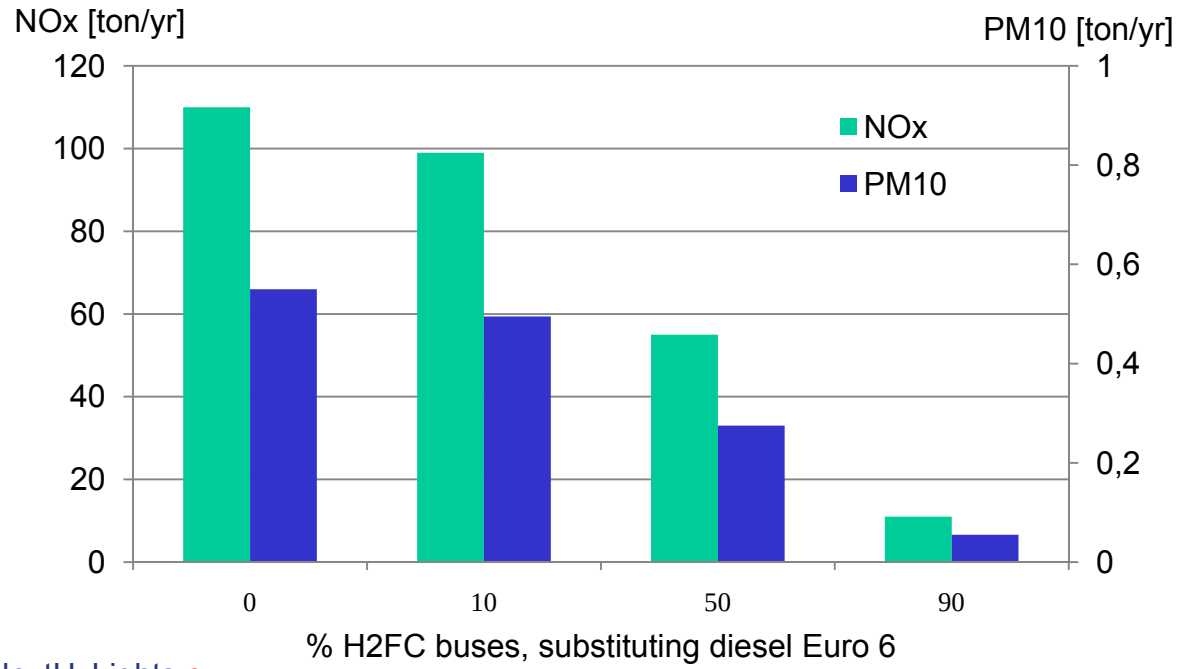
Approach

- City of Amsterdam taken as example, to be scaled to other cities.

- Basis:
  - Amsterdam buses drive about 22 million km per year
  - Future (2025) bus fleet assumed to be all Euro 6
  - Associated ‘real’ life emissions based on several literature sources.

Some initial results

- All Euro 6 diesel bus fleet Amsterdam in 2025 will still emit about:
  110 ton of NOx and 0,55 ton PM10 (ultra fine soot particles)
- Introducing H2FC buses leads to substantial air quality improvement:



Production and transport of hydrogen: Defined per demo-project

Values for efficiency of vehicles and

expected km/run Light duty vehicles

expected h/day and annual availability Special vehicles

The emissions model will be used for each demo-project and it will use additional info as presented in the following format (to be sent after the meeting):

Name of the demonstration project _____

Type of vehicle ☐ Cars ☐ Buses ☐ Special

Data from the demonstration project

Country of deployment _____

City _____

Period (time) from to _____

Size of the fleet (# of units) _____

Type of vehicle _____

Average run per year (km/vehicle) _____

Fossil fuel version ☐ Diesel ☐ Gasoline

gCO2/km _____

gNOx/km _____

Fossil fuel version (km/l) _____

Hydrogen vehicle (type)

☐ Hydrogen ☐ Hydrogen + fossil ☐ Hydrogen + other? Specify _____

Emissions (gCO2/km) _____

Extra fuel consumption (km/MJ) _____

Hydrogen consumption (MJ/km) _____

Note: LHV for hydrogen energy

Hydrogen supply to the vehicles:

Production

☐ On-site ☐ Off-site Other: _____

Process _____

Location of production _____

Transport

☐ Cylinder liq. ☐ Pipeline ☐ Cylinder gas Other: _____

Pressure (MPa) _____

Station

Storage ☐ Cylinder liq. ☐ Pipeline ☐ Cylinder gas Other: _____

Pressure (MPa) _____

Compression ☐ Yes ☐ No

Delivery pressure (MPa) _____

- Next steps
  - Run the emissions model for buses
    - Cooperation ECN and EE
  - Scenarios per (selected) city for air quality (buses)
  - Emission scenarios for passenger cars and niche vehicles in demo stage

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