The role of cities and regions in the early rollout of hydrogen transport

A best practice guide

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• Introduction

• Hydrogen transport: current status and future outlook

• Local support options

• Case studies
A best practice guide to inform policy makers of the role of cities / regions in supporting zero emission transport

Document purpose and audience

- This document is a **best practice guide for cities and regions** seeking to encourage the rollout of hydrogen transport during the sector’s early commercialisation phase.
- The main target audience for this document includes:
  - Policy makers at city / regional level across Europe.
  - The wider hydrogen transport sector.

Document structure

| Hydrogen transport: current status and future outlook | • Motivation for supporting hydrogen transport.  
• Current status of the technology.  
• Deployment challenges and rationale for public sector intervention.  
• National and international actions.  
• Requirements and expectations of industry. |
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<td>Local support options</td>
<td>• Palette of policy mechanisms available for local support of hydrogen transport.</td>
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<td>Case studies</td>
<td>• Examples of measures taken in Copenhagen and London.</td>
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• Introduction

• **Hydrogen transport: current status and future outlook**

• Local support options

• Case studies
Various economic, environmental, and energy security drivers provide a rationale for transitioning to low emission transport systems

<table>
<thead>
<tr>
<th>International motivations</th>
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<tbody>
<tr>
<td>• Obligatory fleet average vehicle CO₂ emission limits are set at the EU level: 130gCO₂/km by 2015, 95gCO₂/km by 2021.</td>
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<tr>
<td>• This has led to average CO₂ emissions of new cars falling from c.140g/km in 2010 to 132g/km in 2012 (EU level) and provides an incentive for automotive OEMs to develop low emission vehicles.*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National motivations</th>
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<tbody>
<tr>
<td>• Many countries seek to encourage uptake of low emission vehicles to meet medium to long term climate objectives. E.g. Denmark’s target to reduce GHG emissions by 40% by 2020 (from 1990 levels) and the UK’s ambition for mass transition to ultra low emission vehicles (ULEVs) by 2050.</td>
</tr>
<tr>
<td>• Increasing energy security by reducing reliance on imported fossil fuels is another national level strategic driver.</td>
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<table>
<thead>
<tr>
<th>Local motivations</th>
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<tr>
<td>• Some cities / regions have their own CO₂ emission reduction targets. A more urgent motivation is the need to improve air quality, particularly in cities. Poor air quality causes premature deaths and estimated annual health costs of around £2bn in London, for example.**</td>
</tr>
</tbody>
</table>

Hydrogen fuel cell electric vehicles (FCEVs, along with other ULEVs) are considered a promising technology to enable the transition to a low emission surface transport system. This has led to:

• Significant investments in technology development (by automotive OEMs and hydrogen refuelling infrastructure providers).
• Public sector support for the technology at EU (e.g. FCH JU) and national levels.
• Development of national strategies for hydrogen transport (e.g. Germany, the UK, France, Scandinavia and the Netherlands).
• Initial deployment of vehicles and infrastructure in certain areas.

* Source: European Environment Agency.
** Source: Clearing the air: The Mayor’s Air Quality Strategy, Greater London Authority (2010), p.16.
A number of global automotive manufacturers (OEMs) are developing FCEVs as a zero emission mobility solution.

**Hyundai** is producing up to 1,000 units of its ix35 FCEV before introduction of a second commercially available model in larger numbers from later in the decade.

**Toyota** has announced plans to bring an FCEV to market in 2014/15 (starting in Japan, followed by Europe and North America).*

**Honda** is now introducing its second generation of pre-commercial FCEVs in Japan, the US and Europe.

**Daimler** is working towards introducing a fuel cell vehicle from around 2017/18.

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**Strategic partnerships between automotive OEMs**

- **Toyota and BMW** have formed a technology-sharing partnership to develop the market for wider scale rollout of FCEVs from 2020.
- **Daimler, Nissan and Ford** have formed a strategic cooperation to develop market-ready fuel cell technology.
- **GM and Honda** are collaborating on fuel cell technology development.

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*Further details were announced at the Los Angeles Auto Show in November 2014. The Mirai will be on sale in Japan from mid-December 2014 and in the US and selected European markets from mid-2015.
A number of other fuel cell vehicles are being developed and brought to market

### Novel fuel cell vehicle concepts

- **Intelligent Energy** (UK) has developed fuel cell systems that are “applicable to many types of vehicle”. Intelligent Energy has worked with a number of companies to develop and trial fuel cell taxis (with LTI), scooters (with Suzuki), and vans (with PSA Peugeot Citroën).*

- **Symbio FCell** (France) is developing fuel cell range extenders and full power systems for light commercial vehicles / medium size trucks. A fleet of Renault Kangoo Z.E. vans equipped with a Symbio range extender fuel cell system went on trial with La Poste in France in 2014.

- A number of light-weight, high-efficiency, hybridised vehicles designed for city and regional transport are currently being demonstrated. Companies active in this area include **Riversimple** (UK), **Microcab** (UK), and **H2O e-mobile** (Germany).

- Fleets of fuel cell buses have been in regular service in a number of European cities (e.g. Aargau, Bolzano, London, Milan, Oslo). Organisations active in this sector include **Daimler Buses** (Germany), and a number of bus suppliers using Ballard fuel cells: **Van Hool** (Belgium), **APTS** (Netherlands), and **Solaris** (Poland).

* See [www.intelligent-energy.com/automotive/case-studies](http://www.intelligent-energy.com/automotive/case-studies). These are examples of some of Intelligent Energy’s activities to date. Details of vehicles to be marketed more widely have not been announced (as of 2014).
Hydrogen refuelling stations (HRS) are also being developed and demonstrated in increasing numbers

Preparing for wider deployment of HRS

- Provision of hydrogen refuelling station networks is critical to allow uptake of zero emission FCEVs.
- Infrastructure is being developed and has been tested in a number of pre-commercial demonstration projects.
- Refuelling protocols and fuel quality standards are now being finalised and implemented by the industry (350 bar / 700 bar refuelling are industry standards).
- HRS fall into two broad categories: on-site H₂ production (via water electrolysis), or delivered H₂. Hydrogen can be derived from a wide range of primary energy sources, including renewables.

Hydrogen refuelling infrastructure providers

The Air Products HRS at Hatton Cross (near Heathrow, London), offering 350 bar and 700 bar refuelling (delivered H₂)

The CHN HRS in Copenhagen, using on-site water electrolysis to produce H₂ from renewable electricity
Hydrogen refuelling infrastructure is being installed in a number of major European cities

Oslo
- Five HRS serving a fleet of fuel cell buses and increasing numbers of passenger cars.

London
- Two HRS, with four more planned by mid-2015 (funding in place).
- Fleet of fuel cell buses operating since 2010 (following initial trial from 2003–2007).
- Fleet of fuel cell taxis running since 2012.
- Fleet of H₂-ICE vans in use for logistics operations (from 2014).
- First ix35 FCEVs delivered in autumn 2014.

Copenhagen
- HRS (H₂ from renewable electricity) and 15 FCEVs in operation since summer 2013.
- Two further HRS due to be opened in 2014.

Hamburg
- Four HRS in operation.
- Around 25 FCEVs being used by various organisations.
- Fleet of fuel cell buses.
- Investigations into large-scale H₂ production from wind, including underground H₂ storage.

Examples of early rollout of hydrogen transport in selected European cities (as of mid-2014, non-exhaustive).

HRS = hydrogen refuelling station(s)
The hydrogen transport sector faces a number of challenges – the case for public sector intervention is made by the benefits available

### Challenges facing the hydrogen transport sector

- **FCEV costs** – vehicle costs are likely to be high while production volumes are low. This means high FCEV prices and / or unprofitable business for OEMs in the early years.

- **Refuelling stations** – a certain level of refuelling infrastructure is needed to make an attractive offer to FCEV customers, which suggests HRS networks must be built in advance of vehicle sales. The economics of HRS investment are harmed by low network utilisation in the early years (due to low vehicle numbers). Furthermore, the risk that vehicles sales do not increase as expected mean that this is a relatively high risk investment.

- **Lack of first mover advantage** – vehicle and infrastructure costs are expected to fall in future (due to economies of scale and technology development). This creates a first mover disadvantage and a challenge to securing investments in the initial HRS networks.

- **Need for coordinated action** – coordination is required between vehicle OEMs and infrastructure providers to create viable business cases for hydrogen transport in the medium term.

- **Cost / benefit split** – without intervention the costs fall on specific parties (OEMs, HRS providers, early adopters), but the benefits accrue to society as a whole.

*It is widely acknowledged that there are no regions in Europe where the private sector will deliver HRS networks without some form of public sector support.*

### Benefits of hydrogen transport

The benefits available from wide-scale uptake of hydrogen-fuelled vehicles include:

- **Decarbonising road transport** – hydrogen can be produced from various energy sources, including renewables. FCEVs therefore provide the potential to decarbonise road transport.

- **Creating new economic opportunities** – local economic benefits can be realised through the new opportunities created across the value chain.*

- **Diversifying energy supply** – including reducing reliance on imported fossil fuels.

- **Reducing local environmental impacts of road transport** – FCEVs produce less noise than conventional vehicles and no harmful tailpipe emissions, leading to air quality improvements.

* E.g. it is estimated that over 40 Danish companies were involved across the value chain in building Copenhagen’s first hydrogen refuelling station.
A long-term view on public sector support for hydrogen transport will be required for widespread uptake and for the benefits to be realised

- In the early stages of hydrogen transport commercialisation FCEVs are expected to come at a cost premium and the refuelling infrastructure is likely to be under-utilised.
- Analysis in London, Denmark, and the UK all suggests that a sustained period of losses will be required before a network can become profitable.
- However, the medium to long-term benefits of FCEVs create a case for public sector intervention.

![Diagram showing investment cash flow for FCEVs and HRS infrastructure, with a decreasing FCEV price, and present day low subsidy, low sales, and high sales, tax reintroduction in 2025?](image)
The availability of affordable hydrogen-fuelled vehicles is a constraint, as is the uncertainty on vehicle launch dates and prices.

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<td>H₂ICE LCV</td>
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**Phase**
- Demo projects / development
- Early commercial
- Mass market introduction

*In selected launch markets, based on public announcements.*
Further rollout of hydrogen transport requires public sector support – there are also expectations of the industrial organisations involved

<table>
<thead>
<tr>
<th>Industry’s needs</th>
<th>Expectations of industrial organisations</th>
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<tbody>
<tr>
<td>• <strong>Policy support</strong> – some level of public sector support for hydrogen transport is needed to make a region an attractive launch market for the technology.</td>
<td>• <strong>Provide clarity on FCEV availability (and prices)</strong> – policy-making to support hydrogen transport is made more challenging while uncertainty remains over FCEV prices and availability. OEMs are requested to provide as much advanced information as possible.</td>
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<td>• <strong>Clarity</strong> – local regions need to decide whether or not they wish to be early adopter areas for hydrogen transport.</td>
<td>• <strong>Avoid over-promising</strong> – the hydrogen transport sector needs to avoid damaging hypes.</td>
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<td>• <strong>Continuity</strong> – support mechanisms for hydrogen transport need to be designed recognising the expected timescales of the transition. Long-term, stable mechanisms are most effective.</td>
<td>• <strong>Support vehicles locally</strong> – OEMs must implement local support for FCEVs to ensure that early customers are not inconvenienced.</td>
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<td>• <strong>Initial market creation</strong> – the public sector can have a role in developing early markets for FCEVs (explored in more detail in the following section).</td>
<td>• <strong>Build and maintain HRS</strong> – infrastructure providers are expected to deliver and maintain HRS to ensure very high availability levels.</td>
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<td>• <strong>Partnership to support the early rollout</strong> – public bodies can work with industry to seed initial HRS networks and deploy the first fleets of vehicles. European projects such as HyTEC and HyFIVE are good examples of city authorities fulfilling this role.</td>
<td>• <strong>Technology development</strong> – continue to develop the technology to improve the offer to customers and prepare for the removal of public sector support and wider rollout in the medium term.</td>
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Government and industry-led groups are involved in planning a network expansion across Europe

**Scandinavian Hydrogen Highway Partnership (SHHP)**
The SHHP consisting of HyNOR (Norway), Hydrogen Link (Denmark), and Hydrogen Sweden (Sweden) is aiming to create a hydrogen highway consisting of 15 stations, and 30 satellite stations by 2015, which will serve 100 buses, 500 cars and 500 specialty vehicles. Toyota, Nissan, Honda & Hyundai have also signed a Memorandum of Understanding (MoU) with organisations from Norway, Iceland, Sweden and Denmark on the market introduction hydrogen transport during the 2014–2017 period.

**H₂Mobility Germany**
Germany has been engaged in a nationwide initiative to develop plans for a strategic network of hydrogen refuelling stations from 2015. Industry partners include Daimler, Linde, Air Liquide, Total, Shell and OMV. The purpose of this initiative is to establish Germany as a lead market for hydrogen transport.

**UK H₂Mobility**
A joint government and industry consortium similar to the H₂Mobility initiative in Germany is collaborating to plan a UK-wide network expansion. Consortium members include large multinational OEMs such as Nissan, Daimler, Hyundai and Toyota.

**France & Switzerland**
French and Swiss equivalents to the flagship H₂Mobility programmes: \( H_2\text{-Mobility Swiss} \) and \( H_2\text{Mobilité France} \).

**Fuel cells and hydrogen joint undertaking**
The FCH JU has 1.4 billion euros in funding available to Europe-wide projects to 2020.
National strategic infrastructure planning is a key first step towards rollout and may be informed by local support policies

### National level hydrogen refuelling station planning

- H₂Mobility-type approaches are examples of public-private initiatives supporting the initiation of FCEV markets by strategically coordinating infrastructure deployment. This can help countries organise efforts, understand where early adopters will purchase vehicles and hence define suitable locations for infrastructure.

- This level of planning determines HRS numbers required on a national level. Local policies supporting zero emission transport may dictate the priority early adopter regions.

- Infrastructure deployment should reflect the gradual uptake of FCEVs. Any investor in HRS must take a long-term view and government support needs to recognise the extended commercialisation period for the hydrogen transport sector.

### Example: strategic infrastructure planning in Denmark

<table>
<thead>
<tr>
<th>Strategic coordination of HRS network for a small initial vehicle fleet</th>
<th>Larger rollout of infrastructure, for mass introduction of vehicles</th>
</tr>
</thead>
</table>

Further HRS deployment over time as FCEV sales increase

Source (map): Ludwig-Bölkow-Systemtechnik GmbH.
Regions interested in becoming attractive FCEV markets may consider implementing support mechanisms to encourage uptake in the early years

The role of local support in the context of national plans

- With national plans and support for hydrogen transport in place, local policies (targeted incentives) can be used to provide an attractive proposition to certain early adopters. However, local measures are generally not sufficient in isolation – national-level policies are also required.

- Policy-making and planning for the introduction of new vehicle types is challenging given the remaining uncertainties. This suggests a need to hedge policies and plans as far as possible (e.g. implement policies that are applicable to all zero emission vehicles).

- The following section describes a palette of measures that local authorities could consider implementing to support the rollout of hydrogen transport.

Few customers are willing to pay a premium for FCEVs

Willingness to pay of different consumer groups in alternative HRS network scenarios

Only certain types of consumer will pay a premium for an FCEV, and willingness to pay is sensitive to the availability of refuelling stations (HRS) in the local area.

Source (graph): UK H₂Mobility, Phase 1 Results (April 2013), p.12.
Alignment of international, national and local policy is important in driving the uptake of new vehicle technologies

Once international and national frameworks are in place local actors can choose from a wide range of measures designed to encourage the uptake of FCEVs. The following slides illustrate examples of local policies from various countries across the world.

<table>
<thead>
<tr>
<th>Government</th>
<th>Key Roles</th>
<th>Examples</th>
</tr>
</thead>
</table>
| International | • Driving down emission levels  
• Encouraging vehicle availability  
• Initiating infrastructure studies on a national level | • EU fleet CO₂ regulation  
• CAFE standards (US)  
• UK H₂Mobility (FCH JU), H₂Mobility Germany (NOW) |
| National | • Strategic infrastructure planning  
• Financial support for reducing infrastructure and vehicle costs | • Plug in car grant (UK)  
• Road tax exemptions (Norway)  
• Funding for a national refuelling network |
| Local | • Additional financial incentives  
• Introducing convenience factors  
• Supporting OEMs and infrastructure providers  
• Raising consumer awareness | • Access to bus lanes  
• Free parking  
• Congestion Charge exemption  
• Exemption from tolls  
• Subsidies for infrastructure development  
• Low emission zones  
• Tax reductions for businesses that offer land for infrastructure |

Alignment at the international, national and local levels can create an environment conducive to the deployment of FCEVs and refuelling infrastructure. Local policies must supplement national mechanisms, they are not sufficient in isolation.
• Introduction
• Hydrogen transport: current status and future outlook
• **Local support options**
• Case studies
A palette of mechanisms is available, from which local authorities will need to select the most effective / appropriate for their region.

- Even after national support, a cost gap may persist for FCEVs vs. conventional vehicles.
- Local authorities can play a role in supporting hydrogen transport and increasing the overall attractiveness of FCEVs – a palette of options is summarised below and further illustrated on the following slides.

<table>
<thead>
<tr>
<th>Short term (early commercialisation)</th>
<th>Medium term (to 2020 and beyond)</th>
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<tbody>
<tr>
<td><strong>Vehicles</strong></td>
<td></td>
</tr>
<tr>
<td>- Free parking</td>
<td>• Air quality directives (low emission zones)</td>
</tr>
<tr>
<td>- Fast-track parking permit applications</td>
<td>• Access to restricted areas (quiet zones)</td>
</tr>
<tr>
<td>- Local tax exemptions</td>
<td>• Regulation to force uptake in certain segments (e.g. taxi fleets, delivery vehicles)</td>
</tr>
<tr>
<td>- Access to bus lanes / high occupancy vehicle lanes</td>
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<tr>
<td>- Exemption from toll charges (ferries / bridges / motorways)</td>
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<tr>
<td>- Public sector procurement</td>
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<tr>
<td><strong>Infrastructure</strong></td>
<td></td>
</tr>
<tr>
<td>- Identify / earmark sites for HRS</td>
<td>• Implement local planning regulations to favour HRS</td>
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<tr>
<td>- Direct support for infrastructure (grants / loans / equity investment)</td>
<td>• Develop a consensus on network planning</td>
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<tr>
<td>- Develop an overall awareness-raising strategy and coordinate activities at a city / regional level</td>
<td>• Provide tax reductions for businesses that offer land for HRS</td>
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<tr>
<td>- Support promotional events (e.g. attendance of high profile individuals at station openings, first FCEV introductions, etc.)</td>
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<tr>
<td>- Place FCEVs with high profile fleet users</td>
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<tr>
<td>- Organise regular local promotional campaigns</td>
<td></td>
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<tr>
<td>- Facilitate training of fire service, regulators, end users</td>
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<tr>
<td><strong>Awareness</strong></td>
<td>• Educational programmes (e.g. education centres at selected HRS)</td>
</tr>
<tr>
<td>• Educational programmes (e.g. education centres at selected HRS)</td>
<td>• Dissemination of experiences of early adopters (e.g. public sector fleets) to targeted audiences and the general public</td>
</tr>
</tbody>
</table>

Note: the types of policies that can be implemented by local authorities are sometimes restricted. E.g. the City of Copenhagen is unable to allow free parking for FCEVs without changes to policy / regulation at the national level.
Financial incentives and convenience factors can be delivered by local authorities, making the overall FCEV package more attractive

- **Parking space**: lack of parking is a common complaint among drivers in large cities. Offering dedicated FCEV (or zero emission vehicle) parking provides a time saving incentive for early adopters.

- **Parking permits**: allowing drivers to jump the queue for local parking permits (a policy used to encourage EV adoption in Amsterdam). This low cost measure can deliver a significant convenience factor for consumers.

- **Free parking**: reduces the annual ownership cost for FCEV drivers (valued at hundreds of euros per year in some cases).

- **Local vehicle taxes / congestion charging**: exemption from congestion charges such as those in London can deliver significant reductions in the total cost of ownership (up to c. £10,000 (€12,000) for a five year car ownership in London).

- **Access to low noise zones**: some European cities are considering banning or restricting vehicles from certain areas on the grounds of noise, particularly for late night deliveries (e.g. Barcelona, Stockholm). Allowing FCEVs access would improve the incentive to own vehicles.

- **Bus lanes / bridge crossings**: permitting FCEVs to use specific parts of the local transport infrastructure (such as bus lanes, or certain bridges from which conventional vehicles are banned) can provide considerable time savings which may justify FCEV purchase. However, such incentives may only be suitable for a limited initial number of vehicles as the benefit diminishes with wider uptake (e.g. continued high uptake of EVs in Oslo has led to bus delays due to the volumes of private cars using bus lanes).
Convenience factors can drive the uptake of new vehicle technologies

**California – High Occupancy Vehicle (HOV) Lanes and the GM Chevrolet Volt**

- Many US states and cities have **HOV lanes**, traffic lanes reserved for use by vehicles with a driver and one or more passengers. HOV lanes are generally created in an attempt to reduce congestion and air pollution.

- In California most EVs and plug-in hybrids can use HOV lanes irrespective of the number of vehicle occupants, allowing drivers to significantly **reduce their journey time**.

- Design changes in 2012 that allowed the GM Volt to qualify for access to California’s HOV lanes led to California’s share of total Volt sales in the US increasing from 10% to 28%.

- It has been estimated that the primary motivation for 90% of these Volt purchases was access to the HOV lanes.

- Furthermore, there is some evidence that HOV lane access affects the resale values of vehicles in California.* Price differences between equivalent models with and without HOV access can be used as a proxy for the value of HOV lane access to consumers.

Combining financial incentives and convenience factors can promote the uptake of new vehicle technologies, as demonstrated in Norway.

Market share of electric passenger cars for 2012 (light colours) and 2013 (darker colours) relative to total sales*

<table>
<thead>
<tr>
<th>Country</th>
<th>2012</th>
<th>2013</th>
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<tbody>
<tr>
<td>Norway</td>
<td>3.3%</td>
<td>6.1%</td>
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<tr>
<td>Netherlands</td>
<td>1.0%</td>
<td>5.6%</td>
</tr>
<tr>
<td>California</td>
<td>2.2%</td>
<td>4.0%</td>
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<tr>
<td>US (incl. California)</td>
<td>1.3%</td>
<td>0.8%</td>
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<tr>
<td>France</td>
<td>0.5%</td>
<td>0.8%</td>
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<tr>
<td>Japan</td>
<td>0.6%</td>
<td>0.5%</td>
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<tr>
<td>Sweden</td>
<td>0.3%</td>
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<td>Denmark</td>
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<td>Germany</td>
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<td>United Kingdom</td>
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<tr>
<td>China</td>
<td>0.1%</td>
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The Netherlands saw a large increase in PHEV sales from 2012 to 2013 (1,900% year-on-year increase), due to high fiscal incentives that in some cases provide a cost saving from owning a PHEV compared to a traditional vehicle. There was also a surge in PHEV sales in this market due to changes to the incentives at the end of 2013.

- Norway has had a package of local support measures (in combination with national incentives such as registration tax and VAT exemption, capital grants and road tax reduction / exemption) in place over an extended period (since 2003).
- Local measures include free use of toll roads & ferries, free parking in public spaces, use of bus lanes, and the rollout of public charging points.
- Together these support mechanisms led to Norway being the electric vehicle market leader (in terms of market share) in 2012 and 2013.

Local authorities can play a role in supporting hydrogen transport both in terms of vehicle uptake and infrastructure deployment

- **Local air quality management**: policies and strategies related to improving air quality and reducing road transport emissions can play an important role in stimulating the adoption of FCEVs e.g. creation of low emission zones.

- **Public procurement**: local authorities can show leadership in the short term by purchasing vehicles on a small scale and showing forward commitment to procure as costs reduce. This provides some level of demand certainty for OEMs bringing FCEVs to a given market.

- **Innovative transport schemes**: many cities are developing multi-modal / car-sharing schemes. Local authorities can increase FCEV deployment numbers by introducing FCEVs into these schemes. This also improves awareness amongst residents.

- **Network planning**: during the early years, optimising the refuelling network is important to keep costs down by avoiding over-building, but still providing a sufficient coverage to allow uptake. Local authorities can help OEMs by supporting network planning exercises through initiating mapping exercises and workshops.

- **Refuelling station siting**: siting refuelling stations in ideal areas can prove difficult due to competition for land. Local authorities can support infrastructure providers by protecting / setting aside land in strategic locations, using planning powers or their own land banks.

- **Consumer awareness exercises**: managing consumer awareness is a useful role which local authorities can fulfil through publicity-raising exercises such as politicians driving vehicles or working with local chambers of commerce to promote uptake.
Regions with a desire to be launch markets for FCEVs must ensure an adequate level of refuelling infrastructure is available

<table>
<thead>
<tr>
<th>HRS network planning – key insights</th>
<th>Implications and recommendations</th>
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<tbody>
<tr>
<td><strong>Level of coverage</strong> – drivers express a strong desire for multiple HRS locally. Developing networks in clusters provides higher convenience and greater confidence in the availability of fuel. Building multiple local stations is generally regarded as more important than a national network (initially).</td>
<td>Regions seeking to be launch markets for FCEVs should install <strong>networks of HRS</strong>, informed by a local strategy for hydrogen transport which is consistent with national plans. HRS need to be installed (not just planned) to be of value to potential customers.</td>
</tr>
<tr>
<td><strong>Catchment areas</strong> – experience suggests that typical customers based &gt;20km from an HRS will not consider purchasing an FCEV. However, relatively high coverage can be provided with small numbers of well-sited HRS.*</td>
<td>How to link to other early adopter regions should be considered, as should the <strong>overall offer to customers</strong>. This may highlight the need for policies to support vehicle uptake (see above).</td>
</tr>
<tr>
<td><strong>Wider links</strong> – although local HRS should be prioritised, it is important to provide links to other regions / countries so that FCEV drivers do not feel isolated. Long distance mobility is a key advantage of FCEVs.</td>
<td>A clustering approach fits with some OEMs’ expectations of the rollout – i.e. a gradual increase in FCEV numbers (selected fleets in the early years, slowly expanding to the wider vehicle market).</td>
</tr>
<tr>
<td><strong>Clustering</strong> – an alternative to HRS deployment via national-level plans. This approach is being taken in France and involves small, local HRS linked to captive fleets to provide high utilisation.</td>
<td>Successful commercialisation of hydrogen transport will ultimately depend on a Europe-wide market being established. This suggests <strong>action by multiple regions</strong> (to become early adopter areas) is needed in parallel.</td>
</tr>
</tbody>
</table>

* E.g. 11 HRS across Denmark could put 50% of the population within 15km of a station, six HRS in London could ensure all the city’s residents are within 13km of a station.
Vehicle emission legislation may act as a useful measure to stimulate uptake of FCEVs

- Mandated reductions in CO₂ emissions for vehicles is based on European legislation (EC 443/2009) that is forcing manufacturers to offer less polluting vehicles. European emission standards define limits for exhaust emissions of new vehicles (PM, NOx, CO, HC etc.), but these are not yet delivering the required air quality improvements in cities.

- Vehicles with low / zero tailpipe emissions could provide benefits in terms of reducing local pollutants (a particular problem in cities) and hence improve air quality.

- Cities across Europe have implemented Low Emission Zones (LEZs), areas where highly polluting vehicles are restricted (e.g. through bans / high charges for entering). As of 2014, most LEZs affect heavy goods vehicles, buses and coaches. Some also cover vans, cars and motorcycles.*

- As the availability of zero emission vehicles increases, cities could encourage their adoption by introducing / tightening LEZs. For example, charging ICEVs to drive in LEZs while offering exemptions for zero emission vehicles would provide a financial incentive for FCEV drivers. Such policies could reduce local pollution and would align with the objectives of the European Clean Air Directive which has been in place since 2011.

- London’s proposed Ultra Low Emission Zone is an example, where plans are being considered to ensure all vehicles driving in central London are ultra low emission.

* See [http://www.lowemissionzones.eu/](http://www.lowemissionzones.eu/)
Addressing the consumer awareness barrier will be important to stimulate uptake of FCEVs as the commercialisation phase progresses

- Ensuring a level of awareness of the technology amongst consumers is required for the wider uptake of FCEVs. Examples such as the European Road Tour provide good building blocks.

- Awareness-raising strategies are required to generate sufficient interest in the technology without creating unhelpful hypes, and to ensure that media interest is maintained via new and original activities.

- Local authorities seeking to increase consumer awareness of FCEVs may want to create an agenda where:
  - Publicity exercises are planned regularly throughout the year.
  - Engagement of groups who influence large fleets within the city (e.g. via chambers of commerce) is included.
  - A strategy is incorporated which is adapted from previous exercises e.g. the first exercise is a European Road Tour, the second exercise is a politician driving FCEVs at a specific event etc.

- Further lessons can be learnt from European car sharing schemes (car clubs) based on EVs such as Autolib in Paris and car2go in Stuttgart, which have managed to create large user registration bases. As a consequence EVs have been brought to the widespread attention of consumers in these cities.

FCEVs on the European Road Tour
(part of H2Moves Scandinavia)
Source: thegreencarwebsite.co.uk
• Introduction
• Hydrogen transport: current status and future outlook
• Local support options
• Case studies
## Case study 1: Copenhagen, Denmark

### Strategic context
- Danish ambition: 100% renewables in the energy and transport sectors by 2050.
- Copenhagen target: carbon neutral by 2025, improve air quality (2025 Climate Plan).
- Copenhagen’s 2025 goals: municipality fleet to be 85% EV & FCEV, 5–10 HRS, 20–30% of passenger cars in Copenhagen to run on electricity / H2 / biomass, 100 wind turbines.

### National incentives / actions
- Exemption from new car registration tax for EVs weighing <2,000kg.
- Plans for national HRS network from 2015 (as part of Danish Energy Plan).

### Local policies / actions
- Public sector procurement (15 FCEVs in fleet since 2013).
- Placing cars in municipal fleet with a wide range of end users → increased awareness.
- *Super end user* hotline for day-to-day support of FCEV drivers.
- Supporting educational activities & test drives.

### Progress to date
- 15 OEM FCEVs in municipal fleet since 2013.
- One HRS, two more planned by the end of 2014.

### Key lessons
- Long-term, cross-party political agreement on national renewable energy ambitions and local Climate Plan provides a stable platform for action.
- Nordic dialogue with OEMs has been effective (i.e. small markets acting collectively).
- Education and vehicle test drives are important.
- Developing a hydrogen transport system leads to new opportunities in fuel cell and hydrogen technology (academic and industrial).
### Case study 2: London, UK

**Strategic context**
- UK commitment to 80% GHG emission reduction by 2050 (compared to 1990) means near total decarbonisation of the transport sector is required.
- Poor air quality in London gives a strong incentive to reduce emissions.
- Mayor’s Transport Strategy (2010) recognised need to support uptake of zero emission vehicles, and Air Quality Strategy aims to reduce road transport emissions in London.
- On-going work on a new *Ultra Low Emission Zone*, and *Transport Emissions Action Plan*.

**National incentives / actions**
- Up to £5,000 / £8,000 grant for new electric cars / vans meeting eligibility criteria.
- Exemption from VED (annual circulation tax) for all vehicles emitting <100gCO$_2$/km.
- Company car benefit in kind rate of 0% to April 2015 for ZEVs (relatively low rates thereafter).
- 100% first year rate enhanced capital allowances for EVs (tax advantages for businesses).

**Local policies / actions**
- Exemption from Congestion Charge for ULEVs (£10.50/day).
- Requirement for all new taxis to be zero emission capable from 2018.
- Target of 1,000 low emission vehicles in the Greater London Authority (GLA) Group by 2016.
- GLA’s involvement in hydrogen transport projects (CHIC, HyTEC, HyFIVE, LHNE).

**Progress to date**
- Vehicles: eight FC buses, five FC taxis, six OEM FCEVs, six H$_2$ICE vans.
- Infrastructure: two HRS operational (2014), four more planned by mid-2015.

**Key lessons**
- There is a limited market of early adopters willing to pay high premiums for FCEVs.
- Limited refuelling station network can be a barrier to vehicle sales.
- Siting HRS is a major challenge in densely populated cities and takes time.
- Vehicle test drives are critical for overcoming concerns of people unfamiliar with the technology.
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