

ABERDEEN CITY COUNCIL

COMMITTEE	Finance, Policy and Resources
DATE	19 April 2016
DIRECTOR	Pete Leonard
TITLE OF REPORT	FCHJU Fuel Cell Bus Commercialisation Project
REPORT NUMBER	CHI/16/099
CHECKLIST COMPLETED	Yes

1. **PURPOSE OF REPORT**

The purpose of this report is to present the business case for Aberdeen City Council's participation in the Fuel Cell Hydrogen Joint Undertaking's (FCHJU) Fuel Cell Bus Commercialisation Project, which aims to introduce additional vehicles into the City's hydrogen fuel cell bus fleet.

The report outlines project benefits and financial implications associated with the project.

2. **RECOMMENDATION(S)**

That Committee:

1. Agrees to the Council's participation, in principle, in the FCHJU Fuel Cell Commercialisation Project for ten hydrogen fuel cell buses;
2. Instructs the Director of Communities, Housing & Infrastructure to report back to Finance, Policy and Resource Committee with confirmation that external match funding is secured for the project.

3. **FINANCIAL IMPLICATIONS**

The financial implications associated with the FCHJU Fuel Cell Commercialisation Project are outlined in the main issues section of the report.

4. **OTHER IMPLICATIONS**

Aberdeen City has Europe's largest fleet of fuel cell buses, along with the UK's largest hydrogen production and bus refuelling station. The

city has become a centre of excellence for hydrogen and fuel cell technologies and it being recognised international on its achievements so far.

The Aberdeen Hydrogen Bus project in the first year of operations has exceeded expectations with the fleet travelling 250,000 miles – the equivalent distance of each bus driving round the world or travelling 25 times to London and back and carried more than 440,000 passengers on two cross-city routes. The hydrogen production and refuelling station has refuelled the vehicles more than 1,600 times and the station has shown itself to be world-class, with 99.99% availability.

Kittybrewster depot will remain the main bus fuelling station for the Aberdeen Hydrogen Project's buses. However due to the commercialisation project's requirements, a station upgrade or a new refuelling station will be required to support the additional buses and assist in the transition of the Council's fleet to use hydrogen fuel cell vehicles.

A feasibility study will be undertaken at Kittybrewster depot to determine the suitability of the site for a station upgrade and to identify options to minimise the impact on the depot. It should be noted that the refuelling schedule for the Aberdeen Hydrogen Project has effectively mitigated the operational impact on Council fleet vehicles

5. BACKGROUND/MAIN ISSUES

At its meeting on 20 January 2016, Communities Housing and Infrastructure requested a detailed business case that outlined the financial implication of Aberdeen City Council participating in the Fuel Cell Hydrogen Joint Undertaking's (FCHJU) European Fuel Cell Bus Commercialisation Project.

The FCHJU Fuel Cell Bus Commercialisation Project seeks to supply 10 European cities (Figure One) with a commercial and affordable offer for zero emission buses that provide the same range and operational flexibility as diesel buses. The project will secure funding to purchase 140 fuel cell buses and provide the infrastructure necessary for the operation of large bus fleets (of at least 10 buses per location). The coordinated approach will provide meaningful economies of scale and unlock the further cost reductions, which are required for the commercialisation of the technology.

This project will significantly increase the number of hydrogen fuel cell buses operating in Europe, and will include four cities deploying significantly larger fleets than are in operation today (fleets of 30 buses in Cologne, 26 in London and 20 in Birmingham whereas the largest concentration of fuel cell buses is currently a 10 bus fleet in Aberdeen). The project will also see 10 fuel cell buses deployed in Dundee and Aberdeen.

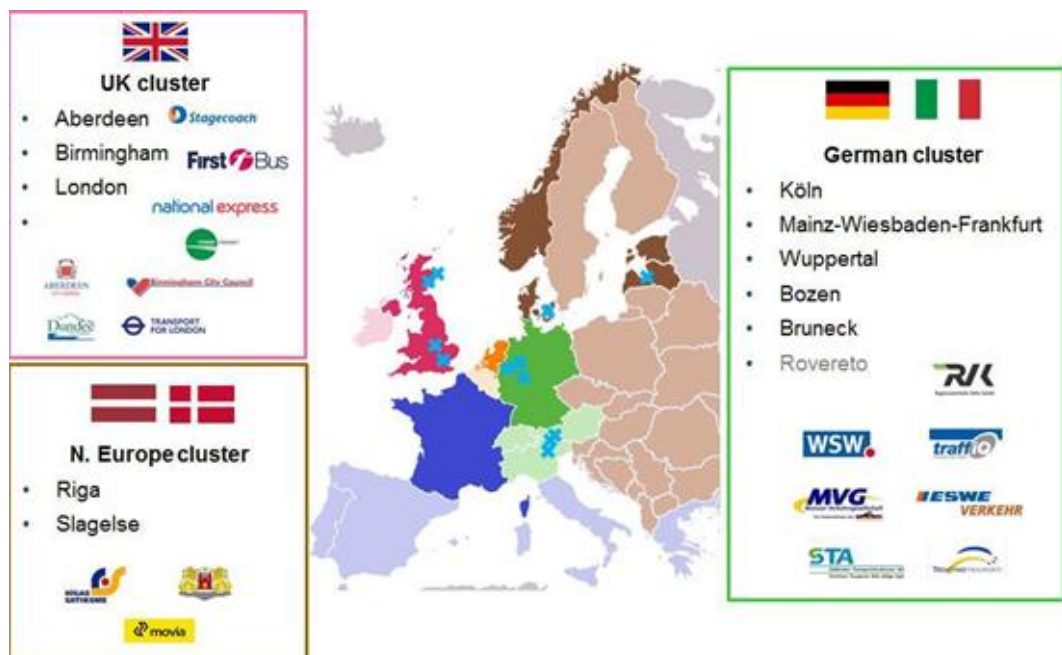


Figure One – FCHJU participant cities

The commercialisation project will increase the size of Aberdeen’s fuel cell bus fleet and is an excellent opportunity to attract additional investment to the city. This is consistent with Aberdeen City Region’s Hydrogen Strategy, which includes an ambition to continue operating the existing fuel cell bus fleet beyond 2018 and to deploy an additional 15 fuel cell buses from this date.

Steps towards delivering other aspects of the strategy have already been taken (e.g. the installation of a new hydrogen refuelling station in Cove (south of Aberdeen) through the ACHES project) and this project provides the opportunity to continue the momentum in the sector and reinforce Aberdeen’s position as a global leader in hydrogen and fuel cell technologies.

The commercialisation project provides a unique opportunity for Aberdeen to work with other cities and industrial partners to transition this sector from a technical demonstration phase towards the ultimate aim of fully commercial zero emission buses being available across Europe and beyond. This type of collaboration lowers the risk to individual cities and offers excellent opportunities to share lesson learned and best practice.

Aberdeen City Council’s investment in the commercialisation project will lead to a range of social, environmental, and economic benefits, including:

- **Greenhouse gas emission reductions and air quality improvements** – an additional fleet of ten zero tailpipe emission buses fuelled by low carbon hydrogen will provide emissions savings of around 630 tCO₂/yr, and reduce concentrations of harmful pollutant such as NO_x and PM₁₀ along the routes served. This is consistent with the legally-binding framework of the Climate Change Act (2008), which requires greenhouse gas emission reductions in the UK of 34% by 2020 and 80% by 2050 relative to a 1990 baseline.
- **Wider energy system benefits** – this project is built on the concept of using hydrogen produced from renewable electricity, which provides tangible links and benefits to the wider energy system. Water electrolyzers offer a variety of energy system benefits, including security of supply, a flexible source of demand for intermittent renewable generators, the ability to provide valuable balancing services to electricity grids, and a versatile energy vector that can be used for cross-sector decarbonisation. Increased generation and use of electrolytic hydrogen will benefit Scotland's electricity system by helping to manage intermittent generation and allowing increased deployment of renewable generators.
- **Domestic fuel production** – producing hydrogen from locally generated renewable electricity leads to economic advantages (a high proportion of the value chain within Scotland) and security of fuel supply benefits and reduce the reliance on fossil fuels.
- **Employment opportunities** – continued expansion of Aberdeen's fuel cell bus fleet will lead to additional opportunities for highly skilled technicians to maintain state-of-the-art vehicles and hydrogen generation / refuelling equipment. Continuing to build a hydrogen economy in Aberdeen along with other Scottish cities will also provide opportunities to develop local supply chains in this area to support the deployment and operation of hydrogen fuel cell technologies.
- **Catalysing wider uptake of fuel cell vehicles** – a commitment from Aberdeen City Council to support the deployment of a new fleet of fuel cell buses will not only demonstrate the city's continuing leadership in this sector, but will help catalyse activities amongst other (non-Council) vehicle end users. This will increase the uptake of fuel cell electric vehicles in the region towards meeting the vision of 94 fuel cell vehicles by 2020 as set out in the Aberdeen City Region Hydrogen Strategy.
- **Attracting further infrastructure investment** – a larger fleet of fuel cell buses will lead to an increased demand for hydrogen. This improves the economic case for continued operation of the existing hydrogen refuelling station and, along with uptake of other fuel cell

vehicles, will help to justify further private sector investments in new stations.

- Positioning Aberdeen as a centre of excellence for hydrogen** – this project is an ideal opportunity for Aberdeen to continue developing expertise in hydrogen and fuel cell technologies. Being involved in a collaborative project of this type will lead to many opportunities to host meetings (of project partners and with other interested parties), which provide direct benefits to the local economy and excellent networking opportunities. This will ultimately lead to opportunities for the Council and other local partners to export the knowledge and skills gained from being at the forefront of hydrogen transport innovations, and thus enhance the economic competitiveness of Aberdeen and north east Scotland.

Fuel cell buses are at a pre-commercial stage and being produced in small numbers. While the upfront costs of the vehicles are high relative to traditional buses, costs are falling with technology developments and increasing production numbers. A central concept of the commercialisation project is to procure zero emission buses and the associated refuelling infrastructure at a level that permits significant cost reductions through economies of scale. Nevertheless, the vehicles and refuelling infrastructure will come at a cost premium over standard buses.

The commercialisation project's funding approach is to use a combination of international public funding, national grants, and local contributions to fund the difference between the costs of hydrogen fuel cell bus to that of a diesel vehicle.

Officers have considered two options for the commercialisation project in Aberdeen - a 10 bus and a 20 bus option. This is based on FCHJU requirement and on the bus operator's appetite to increase the number of hydrogen fuel cell buses in Aberdeen. The total capital and revenue expenditure for each option is summarised in Table One.

	<u>For 10 Fuel Cell Buses</u>	<u>For 20 Fuel Cell Buses</u>
<u>Project Totals (for 10 Year project)</u>	<u>£</u>	<u>£</u>
<u>Capital Expenditure</u>	<u>6,200,000</u>	<u>14,500,000</u>
<u>Revenue Expenditure</u>	<u>6,466,800</u>	<u>14,783,600</u>
<u>Total Expenditure</u>	<u>12,666,800</u>	<u>29,283,600</u>

Table One – Total project expenditure

The capital cost, outlined in Table Two, include the fuel cell buses and the hydrogen refuelling and maintenance infrastructure. The table also outlines the proposed contributions from funding bodies.

	For 10 Fuel Cell Buses	For 20 Fuel Cell Buses	
Capital Expenditure	£	£	
Bus Purchase Cost	5,000,000	10,000,000	Note 1
Re-fuelling Station Infrastructure	1,200,000	4,500,000	Note 2
Total	6,200,000	14,500,000	
Funded By:			
EU Funding	1,440,000	2,880,000	Note 3
Government Funding	2,000,000	4,000,000	Note 4
Other Public Sector Partner Funding	450,000	1,500,000	Note 5
Bus Operator Contribution	1,660,000	3,320,000	Note 6
Aberdeen City Council Non-Housing Programme	650,000	2,800,000	Note 7
Total	6,200,000	14,500,000	
Deficit / (Surplus) Funding	0	0	

Table Two – Capital expenditure and funding

Note 1 - This represents the capital cost of £500k per bus. This cost has yet to be finalised and is the indicated budget cost used by the FCHJU for the commercialisation project

Note 2 – This cost is for the refuelling station upgrade for the Kittybrewster for 10 bus option and the new facility cost for a station to refuel the 20 bus option.

Note 3 – the FCHJU has identified €32m in its funding programme for large-fuel cell bus commercialisation project in 2016. This equates to a funding contribution of £144k per bus. This will be sought through an FCHJU call bid on 3 May 2016.

Note 4 – Scottish Government and the UK Government's Office of Low Emission Vehicles are aware of this project and have indicated funding for refuelling infrastructure and the fuel cell buses.

Note 5 – This figure represents a contribution from private sector project partners and other local agencies

Note 6 - the bus operator's will pay the equivalent cost and exposure to risks of operating a diesel bus. In return the operators will commit to operating the buses and take a partnering approach to the deployment, recognising that there will be new learnings and challenges associated with deploying an innovative, zero emission vehicle technology.

Note 7 – the Council is being asked to fund the project in return for the benefits of fleets of zero emission buses operating in Aberdeen. This figure identified represents the project's remaining capital cost.

The commercialisation project will require the fuel cell buses to operate in Aberdeen for ten years. Operators therefore require the buses to operate at the same cost as a diesel vehicle on a total cost of ownership basis. The annual revenue expenditure and income is based on equivalent diesel cost and is shown in table three.

	<u>For 10 Fuel Cell Buses</u>	<u>For 20 Fuel Cell Buses</u>	
Revenue Expenditure per annum	£	£	
Fuel Cell Bus Maintenance	292,500	585,000	Note 1
H2 Fuel Costs	184,180	368,360	Note 2
Re-fuelling Station Operational Costs	90,000	180,000	Note 3
Financing Costs (Aberdeen City Council)	80,000	345,000	Note 4
Total	646,680	1,478,360	
Revenue Income per annum			
Bus Operator Maintenance Recoveries	292,500	585,000	Note 5
Bus Operator Fuel sales	264,550	529,100	Note 6
BSOG Uplift	93,600	187,200	Note 7
Total	650,650	1,301,300	
Deficit / (Surplus) in Funding per annum	(3,970)	177,060	

Table Three – Annual expenditure and revenue income

Note 1 – This figure represents the annual maintenance cost of £29,250 a bus per annum. This cost is in line with maintenance costs for a traditional diesel vehicle.

Note 2 – This figure represents the total costs that the operator will pay for hydrogen. This is estimated on a bus travelling 65,000km per year and using 0.9kg/100km with the operator paying the equivalent cost of diesel. Additional EU and national funding will be used to offset the difference between hydrogen and diesel costs.

Note 3 – This figure represents the annual operation and maintenance costs to operate the refuelling station.

Note 4 – This figure represents the cost of borrowing at 4% over 10 years for the Council's capital investment, as detailed in Table 2.

Note 5 – This figure represents the bus operator's contribution to the maintenance costs of the buses (as defined in Note 1).

Note 6 – The bus operator will fund the equivalent diesel cost of purchasing hydrogen. However, this cost may require further EU and national funding to offset difference between hydrogen and diesel costs.

Note 7 – Through the Bus Service Operating Grant (BSOG), the operator will be eligible for an enhanced payment equivalent to 14.4p per km. This payment will be used to offset the fuel and maintenance costs for the fuel cell buses.

The commercialisation project's financial model shows that the ten fuel cell bus option currently has a small annual funding surplus of £3,970. This surplus is dependent on the level of external funding contributions. If these contributions do not materialise or are less than forecasted then the Council may be required to increase its funding contribution to make the project financially viable. It should also be noted that due to level of EU funding, the project is exposed to any movement in exchange rate.

For the 20 fuel cell bus option, the project has a funding shortfall of £1.77m per annum. This option does become financially viable if significant additional external funding is secured that minimises the Council's capital investment or if the Council is willing to invest more in the technology given the economic development and supply chain benefits and opportunities identified in the Aberdeen City Region Hydrogen Strategy. However this must be considered within the increasingly challenging financial environment local authorities are faced with.

Officers have been in discussions with the two operators involved in the Aberdeen Hydrogen Bus project. Both operators have indicated that they are interested in participating in the project subject to commercial terms and the funding arrangement outlined above is in place. This commitment has enabled the project to progress the funding bid for the FCHJU call.

Officers will begin working with project partners, external funding bodies and organisations associated with the Council to maximise the external financial contribution. A report outlining the final business case will be presented to Council once all funding contributions are secured.

6. IMPACT

Improving Customer Experience

This proposal will benefit both the operators and the general public in the future by providing clean, quiet, zero emission buses and improving the air quality within the city.

Improving Staff Experience

Working within this technically challenging but rewarding sector has broadened the knowledge, improved project management and negotiation skills of the staff involved in the various projects.

Improving our use of Resources

The reasons for spending public funds must always be analysed to ensure that they are valid and are necessary. This particular project has gone through the validation process and the outcome from this project will reap the rewards for Aberdeen City Council moving forward in terms of providing the general public with clean, quiet, zero emission buses, improving the air quality within the city and the travel and wellbeing of its citizens.

Corporate

This project links to the Aberdeen City Region Hydrogen Strategy and the transport and energy priorities within Aberdeen – the Smarter City Vision to “define the image of an international 21st century energy city, leading a new leaner, cleaner industrial revolution using the intensity of our social, business and community connections” and taking “a European lead in adapting new transport technologies” to “provide and promote a sustainable transport system, including cycling, which reduces our carbon emissions”.

This project also links into the North East’s Regional Economic Strategy - “Further diversification into alternative energy technologies must be accelerated to complement work already being undertaken in shale gas, tar sands, hydrogen fuel cell supply chain opportunities, energy and carbon capture and storage and decarbonising food production.”

This project is also detailed within the Strategic Infrastructure Plan as one of the projects with substantial direct involvement from Aberdeen City Council that contribute to economic growth. It will also offer many opportunities for joint working with partner organisations on projects. One of the key successes of the hydrogen projects to date is the public, private consortiums which have been built. Without this collaborative approach the aims of Aberdeen City Region’s Hydrogen Strategy cannot be delivered. The External Funding Plan reinforces the importance of joined up partnerships at local, national and international level.

Public

This project is of interest to the public in terms of the potential economic and environmental benefits that hydrogen and fuel cell technologies can bring to the City including job creation as well as air quality improvements. Significant local and national air quality benefits can be derived from the deployment of low carbon vehicles offering zero exhaust emissions, reducing harmful pollutants such as nitrogen oxides (NO_x), sulphur oxides (SO_x) and particulate matter (PM₁₀).

7. MANAGEMENT OF RISK

The returns from the Council's investment to date in hydrogen technologies (in relation to economic growth, business diversification, energy security, environmental and air quality benefits) will be reduced without the continuation of investment in Hydrogen and Fuel Cell technologies.

The Council's ambition to continue to be at the forefront of hydrogen technologies will not be met and securing external investment will become more of a challenge.

The level of any capital financing required from Aberdeen City Council can only be determined once the level of external financing is confirmed. An assumption on the rate for capital financing required for the project has been made for financial modelling purposes, which is at the higher level of costs involved.

As the proposal is to including European partners and funding within the project, the Council will be exposed to exchange rate risk between Euros and Sterling. The Council will have to underwrite any significant exchange rate movement which impact on project cash flows.

8. BACKGROUND PAPERS

CHI 15/34 - FCHJU Commercialisation Study
CHI/14/048 - Aberdeen City Region Hydrogen Strategy 2015-2025

9. REPORT AUTHOR DETAILS

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