Developing an alternatively powered vehicle fleet replacement strategy for Aberdeen City Council with consideration given to the development of the city's hydrogen economy

Christopher Ryan

UNIVERSITY OF ABERDEEN

Motivation

Aberdeen City Council (*ACC*) has various legislative obligations to mitigate carbon emissions.

Powering Aberdeen is Aberdeen's first Sustainable Energy Action Plan.

Two of the stated aims of Powering Aberdeen were to '*Undertake fleet review*' and '*Expand the Hydrogen Network*'. These are the two objectives, which for the purposes of this study were examined in order to arrive at a coherent strategy between the two.

Hydrogen Economy

Is the production, transportation and utilisation of hydrogen for commercial purposes.

One of these commercial purposes is as fuel for *Fuel Cell Electric Vehicles* (*FCEV*) and was therefore considered as one of the possible alternatively powered alternatives for the councils fleet alongside *Battery Powered Electric Vehicles* (*BEV*) which are powered by electricity. Currently there are no purposely made *FCEVs* and thus they are only available through a hydrogen conversion of an existent vehicle.

A prosperous Hydrogen Economy

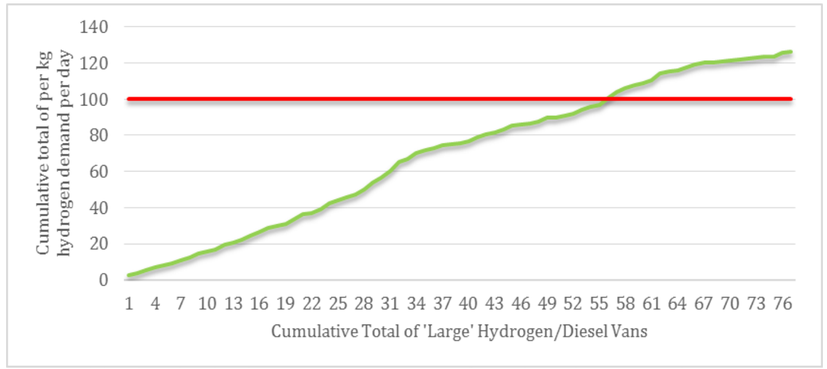
Requires cheap sources of the element and a economical at the pump price of hydrogen at the hydrogen refuelling stations (*HRS*). The underutilisation of *HRSs* is predicted to sustain a high per kg cost of hydrogen in the short to medium term. Thus strategies must be developed to increase the number of *FCEV* on the road prior to the mass commercialisation of *FCEVs*. Economical *HRS* need a demand of over a 100 kgs of hydrogen per day.

Methodology

Calculating the total cost of ownership (*TCO*) over a period of 5 years for all of *ACC*'s incumbent van fleet with BEVs, FCEV and diesel alternatives. *TCO* where calculated for all alternatives for the purchase years of 2016,2017,2018,2019 &2020. The annual levels of CO^2 emissions from the vans within each of the councils services were also determined.

Year	Size of Van	Number of Vans	Number of BEV with lowest TCO	Number of Diesel Van with the lowest TCO	Number of Hydrogen/Electric with lowest TCO	Number of Hydrogen/Diesel with lowest TCO
2016	Small	4	0	4	0	0
2016	Medium	79	73	6	0	0
2016	Large	78	0	78	0	0
2017	Small	4	0	4	0	0
2017	Medium	79	73	6	0	0
2017	Large	78	0	78	0	0
2018	Small	4	73	6	0	0
2018	Medium	79	0	4	0	0
2018	Large	78	0	78	0	0
2019	Small	4	0	4	0	0
2019	Medium	79	75	4	0	0
2019	Large	78	0	78	0	0
2020	Small	4	0	4	0	0
2020	Medium	79	75	4	0	0
2020	Large	78	0	78	0	0

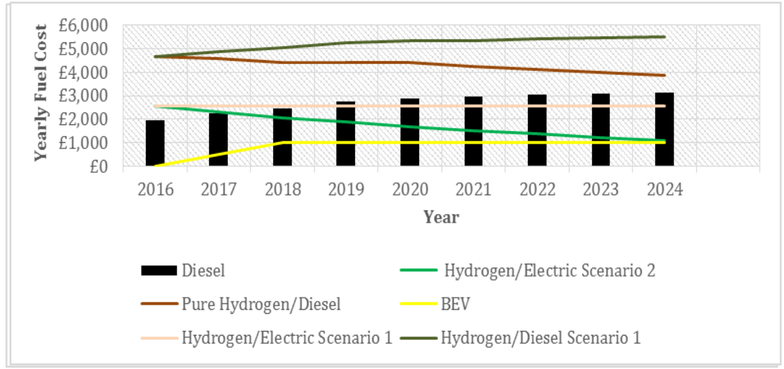
There is strong cost argument for the replacement of mid-sized diesel van with mid-sized *BEVs*



It would take the hydrogen conversion of 55 diesel powered vans, powered only by hydrogen to stimulate over a 100kg of hydrogen a day. On average these *FCEVS* contain a £30000 *TCO* premium.

Aberdeen City Councils Services	Annual emissions of co^2 (tonnes) from their van fleet	Number of Vans
Road Department	55.59	22
Building Services	398.49	94
Aberdeen City Accord	1.80	1
Architecture	1.00	1
Art Development & Art Gallery	2.87	3
Car Park	4.29	3
CYP-RC	1.57	1
Dog Warden	5.27	2
Duthie Park Trust	1.15	1
EDMS	0.70	1
Environmental Control	1.43	1
Facilities	11.82	5
Fleet Services	13.53	5
Ground Department & Maintenance	52.28	17
IT	5.40	2
Library	4.96	1
Pest Control	4.90	3
Refuse Collection	8.33	4
Sweeping	2.62	2
Waste Disposal	0.33	1

Complete decarbonisation of *ACC* van fleet would see a 0.04% decrease in Aberdeen's CO^2 levels of emissions.



By 2018, under the assumption of continued utilisation of the *HRSs,* the yearly cost of hydrogen can equal the price of diesel.

Conclusion

- Mid sized BEV vans on average offer cost advantages over traditional diesel powered alternatives.
- The low level of total emissions from decarbonising all of *ACC's van* fleet coupled with the potential cost advantages of *BEVs* emphasis the needs to develop the infrastructure of *BEV* charging posts.
- The utilisation of HRS will allow for a competitive hydrogen fuel costs.
- The large scaled hydrogen conversion of the councils van fleet is not a cost effective strategy to stimulate demand.

Christopher Ryan christopher.ryan.09@aberdeen.ac.uk

MSc Petroleum, Energy Economics and Finance University of Aberdeen, King's College, Aberdeen, AB24 3FX