Methodology for optimizing the subsidy policy in hydrogen refueling stations deployment. Application to Spanish case.

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The use of Alternative Fuel Vehicles (AFV) to replace vehicles powered by internal combustion, is an alternative form of road transport that may provide, in the long term, security in energy supply, reduction in greenhouse gas emissions and improvement in air quality in cities [1], [2].

Location models are intended to accelerate market acceptance of AFV, making efficient decisions about infrastructure design. One of the main problems which must be addressed in the roll-out of the necessary infrastructure for the use of alternative fuels in transport is the so-called chicken and egg problem [2]. Infrastructure (supply) leads to demand, but in order for the infrastructure to be economically viable, there must already exist a given level of demand. Figure 1 shows the essential elements of this vicious circle involving supply and demand.

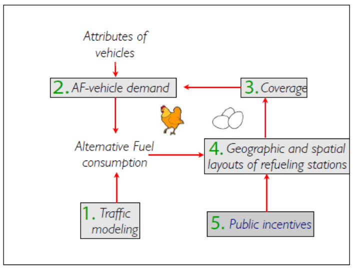

Figure 1: Simplified representation of the elements in the supply, demand and market process of AFV

This problem requires public-private partnerships to overcome the initial stage in the AFV market. A temporary policy of government subsidies can change this situation. This work proposes a Stackelberg equilibrium model for the optimal design of temporary subsidy policies for the deployment of alternative fuel infrastructure. At the upper level, the government provides dynamic incentivization policies for alternative fuel station owners. The behaviour of hydrogen station owners in a competitive environment, the alternative fuel user behaviour (buying of Alternative Fuel Vehicles, making trips and choice of routes) and the availability of alternative fuel are accounted for at the lower level. The model determines the optimum subsidies, which allow a given level of coverage by infrastructure in a certain year. Moreover, the model imposes as a constraint the successful transition of the energy market from the point of view of the infrastructure, i.e the sustainability of the infrastructure without subsidies.

With an annual investment per person between 0.35 and 1.29 € in the 30 years of the study, it can have hydrogen as an alternative fuel in the graph study. A numerical example with a simplified Spanish road network illustrates the proposed model.

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