Bob Rose states that the McKinsey and Company report “confirms the value of fuel cell EVs in our national energy portfolio”, and lists these key points from that report

- FCEVs are the best EV option for longer trips and medium size and larger cars, where they are cost-competitive with internal combustion engines.
- FCEVs have inherent advantages, including better performance and range. FCEV refuelling time is measured in minutes compared to hours for battery EVs.
- Refuelling infrastructure is affordable and in line with other EV options. (“A dedicated hydrogen infrastructure is therefore justified and doable.”)
- Long lead times make it “a matter of urgency” that governments adopt programs to support vehicle sales and infrastructure in the early years.
- While the analysis focuses on Europe, the technology and cost assessment is applicable worldwide –and the policy conclusions are relevant to the United States
  - the U.S. has an even greater percentage of medium and heavy duty vehicles and we drive our cars longer distances

Here are some more details to backup several of Bob’s key points:

1. **FCEVs are ready for commercial scale-up**; here’s how McKinsey and Company put it: “Given satisfactory testing in a customer environment - with more than 500 cars [FCEVs] covering over 15 million kilometres and 90,000 refuellings - the focus has now shifted from demonstration to planning commercial deployment so that FCEVs, like all technologies, may benefit from mass production and the economies of scale.”
2. **FCEVs are the best option for longer trips where they are competitive with ICEVs**. Figure 1 (next page) compares the McKinsey estimated total cost of ownership (TCO) for various vehicles in 2030 and 2050. By 2030, they estimate that the TCO for FCEVs will be less than the TCO for BEVs and PHEVs, although still slightly higher than the TCOs for gasoline or diesel ICVs. By 2050, however, (red bars) they are projecting FCEVs to have the lowest TCO, even lower than gasoline and diesel ICVs. By 2030 they project that a FCEV will cost €32,700 for a large J-segment vehicle, while a large BEV would cost €37,300 and a large PHEV would cost €34,700. For smaller A/B segment cars, the BEV and PHEV would cost less and have slightly lower TCOs. However, they point out that the medium C/D/E-segments & larger J/M-segment cars that travel more than average distances each year account for 50% of all cars in the EU and these medium/large vehicles generate 75% of vehicle CO_2 emissions.

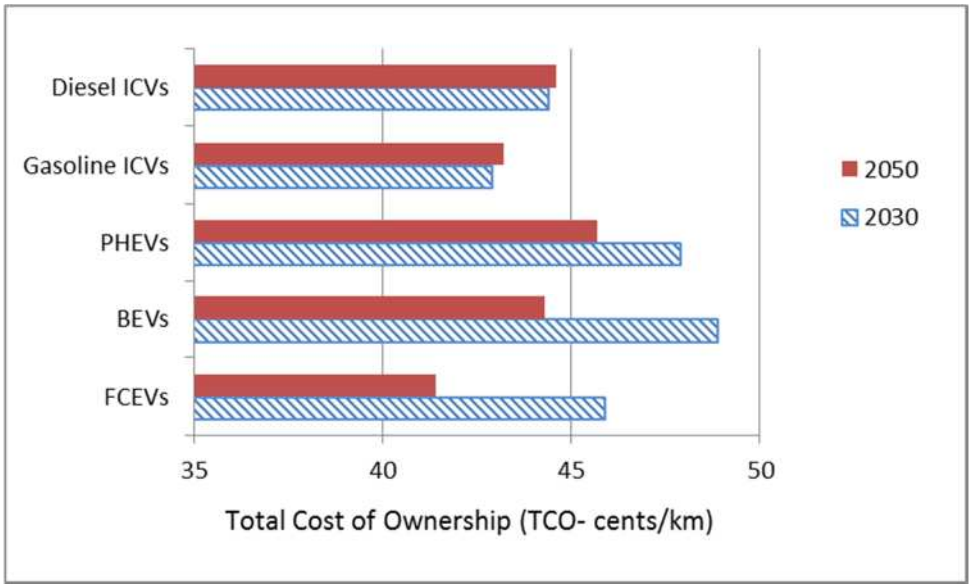

Figure 1. Estimated TCO for large (J-segment) vehicles in 2030 and 2050

3. **FCEVs have inherent advantages** in terms of range and fueling time. As the McKinsey report puts it:
"Owing to limits in battery capacity and driving range[1] (currently 100-200 km for a medium-sized car[2]) and a current recharging time of several hours, BEVs are ideally suited to smaller cars and shorter trips, i.e. urban driving (including new transportation models such as car sharing). With a driving range and performance comparable to ICEs, FCEVs are the lowest carbon solution for medium/larger cars and longer trips." And:
" For example, an average, medium-sized BEV with maximum battery loading e.g. 30 kWh, around 220 kg in 2020) will not be able to drive far beyond 150 km at 120 km/hour, if real driving conditions are assumed (taking expected improvements until 2020 into account). Charging times are longer, even at maximum proven battery technology potential: 6-8 hours using normal charging equipment. Using more sophisticated and expensive technologies can reduce charging time. Fast charging may become widespread, but the impact on battery performance degradation over time and power grid stability is unclear. Moreover, it takes 15-30 minutes to (partially) recharge the battery. Battery swapping reduces refueling time; it is expected to be feasible if used once every two months or less and battery standards are adopted by a majority of car manufacturers. FCEVs have a driving performance and range comparable to ICEs: an average driving range of 500-600 km, similar acceleration and a refueling time of less than 5 minutes, similar to ICE fuelling which is a proven business model. The driving range and performance of PHEVs is similar to ICEs when in ICE drive."

[1] The range chosen in the study for BEVs and PHEVs reflects the car manufacturers' current view on the best compromise between range, cost, and load bearing capacity for the vehicle
[2] For C/D segment cars this will increase to 150-250 km in the medium term. With a smaller battery capacity than BEVs, PHEVs have an electric driving range of 40-60 km. Combined with the additional blending of biofuels, they could show emission reductions for longer trips.

See Annex, Exhibit 56, page 61, for a graphical analysis of the impact of cruising speed on range.

4. **Refueling infrastructure is affordable and in line with other EV options.**
   For example, they estimate that hydrogen infrastructure will cost between €1,000 and €2,000/FCEV, while the costs for electrical charging infrastructure will cost between €1,500 and €2,500 /BEV. In addition, they estimate that the total cumulative cost for a hydrogen infrastructure for the entire EU will be €100 billion over 40 years, while the cost of an EU electrical charging infrastructure will cost over €500 billion over 40 years (excluding the likely added costs of expanding the electrical distribution system to meet growing demand for BEV and PHEV charging.) [Our own detailed computer simulations for the US showed similar infrastructure costs: we estimated a total hydrogen infrastructure cost over 50 years of $80.9 billion ($29.3 billion government subsidies and $51.6 billion of direct industry investments.) and $276 billion to install electrical charging outlets ($41 billion of government support and $234 billion of industry investments in charging infrastructure.) Thus we estimated that the BEV and PHEV charging infrastructure would cost 3.4 times more than a hydrogen infrastructure, while McKinsey estimated that the electrical charging infrastructure would cost 5 times more; both of these estimates exclude the cost of upgrading the electrical transmission system to handle increased power transfer, particularly during the daytime battery charging which most analysts say would be necessary to attract BEV and PHEV purchasers.)
   Note: McKinsey report estimates that the oil & gas, telecommunications, and road infrastructure industries *each* spend €50 billion to €60 billion per year, or a total of €150 billion to €180 billion per year, so the estimated tab of €100 billion over 40 years for building an EU-wide hydrogen infrastructure is reasonable. [note: we estimate that the oil & gas industry has spent more than $100 billion per year over the last three years in the US just to maintain the existing gasoline and diesel fuel infrastructure in the US.]

5. **Authenticity**
   McKinsey and Company report was based on proprietary data from the auto companies: "This study represents the most accurate to date[3], as conclusions are based not on informed speculation, but on confidential, granular and proprietary data, provided by key industry players. This has allowed a true comparison of the power-trains, with all underlying assumptions clearly stated

The full Mckinsey report can be downloaded from:
http://www.europeanclimate.org/documents/Power_trains_for_Europe.pdf

[3] Other studies taken into consideration include "Hydrogen Highway": www.hydrogenhighway.com; Roads2HyCom project www.roads2hy.com; "On the road in 2035", published 2008; "The Hydrogen Economy", published 2009; "Hydrogen Production Roadmap: Technology Pathways to the Future", published 2010