Electric cars are the future, but do we have any alternatives?

Governments around the world are adopting electric vehicle (EV) mandates as the answer to reducing emissions of carbon dioxide, and see this as imperative because of climate change or global warming. Opinions may differ on how cost effective this will be, and we don't want to get into political debate here, so let us consider what options we have based on current state of the industry.

Electric vehicle technology has come a long way in the last 20 years and is now a viable choice for those who can afford it. There are obvious limitations with range and slow charging rates, but those concerns are fading as charging systems improve. For city dwellers the benefits are zero emissions, reduced noise and high efficiency in the short-trip urban cycle. So why not make EV's mandatory for everyone? Well, simply put, they do not meet the needs of everyone, and the infrastructure is not available to meet the demand. Remember that the electric grid can barely support our existing demand and utility companies warn that there will be blackouts again this summer. Nationally, the generation of electricity still uses over 70% fossil fuels so we would need massive long term projects to replace the existing systems and increase capacity. Perhaps we should look for better ways to reduce carbon emissions.

Hydrogen could eliminate our carbon emissions because it burns to form water (H_2O) and no carbon is used in the process. Toyota Mirai is a current model designated FCEV (Fuel Cell Electric Vehicle), where hydrogen is converted to electricity and drives electric motors. Using hydrogen in this vehicle is very efficient, so 1 kg of hydrogen has about the same usable energy as 1 gallon of gasoline. Advocates claim that hydrogen is cheap to produce, but it is difficult to store and distribute so the price of hydrogen in California is still higher than gasoline. Industry is working to reduce the cost of distributing hydrogen and it has potential as a renewable fuel, but will not see widespread adoption until infrastructure is built to make it widely available for vehicles.

Ethanol (or alcohol) is produced by fermenting plant materials such as corn, wheat or sugarcane. The process is similar to producing whiskey and is currently used to make ethanol as a fuel additive. Current gasoline is blended with up to 10% ethanol to reduce emissions and some engines are designed to run on 85% ethanol (E85 fuel). Benefits are that it lowers emissions and it is considered renewable because it uses plants. It is also domestically produced so it reduces our dependence on foreign oil. Critics say that the distillation process is energy intensive and is not good for the environment. Also, increasing the use of ethanol is controversial because it uses food to produce fuel so it could increase food prices and create food shortages.

Sustainable Aviation Fuel (SAF) is a bio-fuel meaning it is produced from biomass or waste plant materials. Jet engines require liquid fuels with high energy density in order

to produce high thrust with manageable weight and jet fuel is similar to kerosene. Airlines are making good progress in switching to SAF to reduce their carbon footprint and it will play a major role for jet engines in the future. Small piston engines in general aviation can burn ethanol or E85 fuel. Biomass energy is also being developed as a source of power for industry and heavy transport but is limited by availability of land and plant resources. It will be part of the solution to clean energy but not the only answer.

E-fuels (electrofuels) or synthetic fuels use electricity from renewable sources (like solar) to synthesize liquid fuel as a drop-in replacement for existing fossil fuels. This is perhaps the most exciting option for car owners because the fuel can be engineered to suit any existing vehicle with no modifications to the engine. The principle is to capture hydrogen and carbon dioxide and use them to produce hydro-carbon fuels. Lab scale processes have demonstrated the potential but much development is needed to make the fuels competitive with fossil fuel from crude oil.

All of these options require development to make them ready for the mass market and the industry is working hard to make it happen. The future has endless potential and that is why we need more engineers!

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