“You have one billion pounds to spend on research: how are you going to use them?”

In recent years climate change has prompted the need for a transfer from fossil fuels to renewable energy. With the recent growth of electric vehicles on the road, is it time to start looking to the skies? Electric aviation as an idea is becoming very prevalent and could be an idea on the road to becoming the next Elon Musk. However, commercially they are not adequate due to their large battery mass and poor energy discharge compared to jet fuel. So, in this essay, I am going to look at the feasibility of pioneering electric flight with the help of a billion pounds. Looking at the progress to date, what the predictions for future development are perceived to be as well as the hurdles to be faced.

The main predicament faced is the problem of overcoming the insufficient utilisation of energy efficiently. Current batteries are not energy-dense enough for electric aviation because they are too heavy and the amount of weight in a plane, unlike a car is exceedingly crucial.

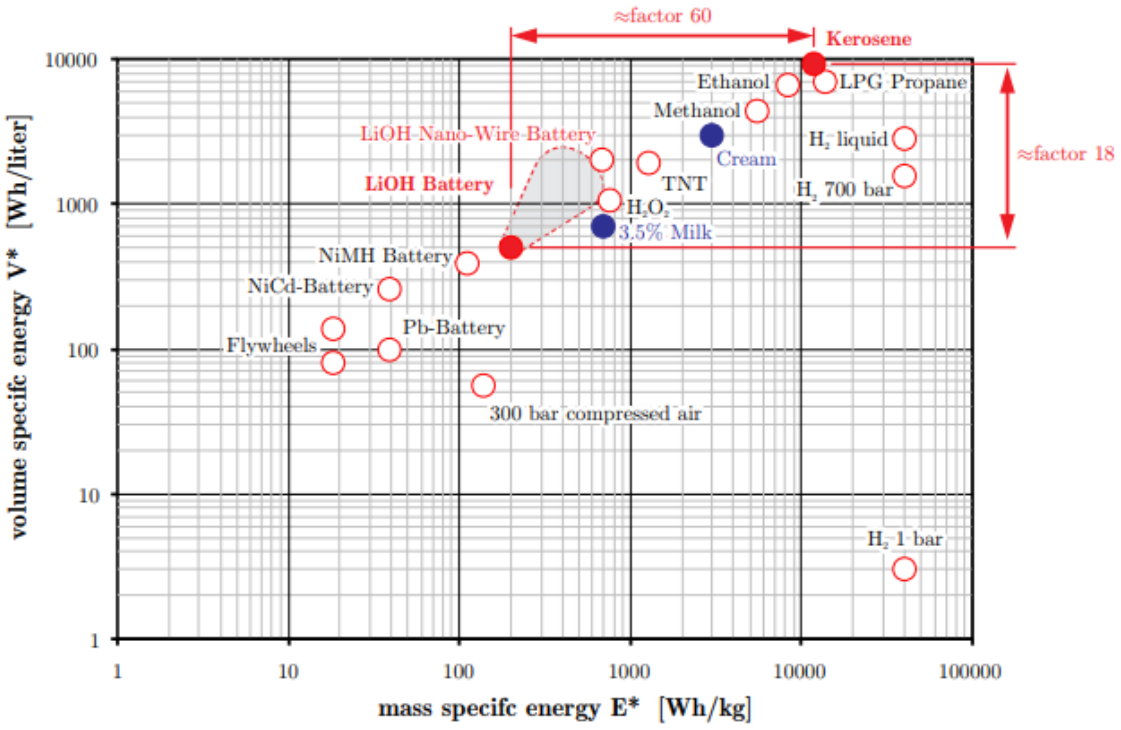

Figure 1, (Hepperle, 2009)

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Figure 1 portrays the efficiency of different fuel types by comparing E to V on an exponential graph. The battery systems tested were the most advanced current battery storage systems and they still greatly fall short of the parameters of Kerosene. 'While the factor in specific volume is only about 18, the factor in mass-specific energy density is in the order of 60.'(Hepperle, 2009) This shows the orders of magnitude that battery storage systems to need to catch up to.

	777–8	777–9
List Price	$410.2 million	$442.2 million
Program Launch	November 2013	
Seats (2-class)	384	426
Range	Up to 8,730 nmi (16,170 km)	7,285 nmi (13,500 km)
Length	229 feet (69.79 m)	251 feet, 9 in (76.72 m)
Wingspan	Extended: 235 feet, 5 in (71.75 m) On ground: 212 feet, 8 in (64.82 m)	
Interior	Larger windows, wider cabin, new lighting, new architecture (more)	
Configuration	Twin-aisle (widebody)	
Engine	GE9X, supplied by GE Aviation	

Figure 2, (Boeing, 2020)

To analyse the new Boeing 777 doing a long haul flight it is clear that for electric aviation to be adopted by the consumer market it will have to be able to compete with typical jet fuel planes. Based on the current technology it is estimated that the energy density of batteries will need to be 30x more than it is now. This will require a massive leap of discovery in this field to achieve this, so, it is unfeasible that electric planes will be completing long haul flights any time in the foreseeable future. 'it would only be possible to fly an A320 airliner for a fifth of its range with just half of its payload, says Airbus's chief technology officer Grazia Vittadini.' (Bowler, 2019)

A possible future barrier will be access to silicon, for the creation of batteries, although electrical energy doesn't produce outrageous greenhouse gases. The development of electric vehicles and most predominantly the batteries are expensive and cost-inducing in their own right. For example, when mining lithium 50% of the reserves are in some of the driest regions of Argentina, Chile and Bolivia and 'Lithium mining requires huge amounts of groundwater to pump out brines from drilled wells, and some estimates show that almost 2 million litres of water are needed to produce one ton of lithium.' (UNCTAD, 2020) Also, the environmental positive change from transferring from fossil fuels will not be as drastic as initially perceived because '80% of the aviation industry's emissions come from passenger flights longer than 1,500km' (Bowler, 2019) so even with a total overhaul of short-haul flights with electric planes the goal of reducing global

carbon emissions is still too lofty. To encapsulate, long haul flights will not be a possibility to develop within a billion-pound budget.

There is still an opportunity with short-haul flights because energy storage is not as soaring a requirement. With rapidly increasing interest in electric aviation, many large companies are spending money on research into electric flight potential. ‘For example, Rolls-Royce, Airbus and Siemens are working on the E-Fan X programme, which will have a two megawatt (2MW) electric motor mounted on a BAE 146 jet. It is set to fly in 2021.’ (Bowler, 2019) There is also development already having success, an Israeli firm called Eviation has developed a short-haul flight, ‘called Alice - will carry nine passengers for up to 650 miles (1,040km) at 10,000ft (3,000m) at 276mph (440km/h). It is expected to enter service in 2022.' (Bowler, 2019) From a business standpoint, the main profitable section will be savings in fuel consumption when looking at typical costs electricity is exponentially cheaper than kerosene.'magniX chief executive Roei Ganzarski says that with two billion air tickets sold each year for flights of under 500 miles, the business potential for small electric passenger aircraft is clear.' (Bowler, 2019) An example to demonstrate the profitable return of electric flights is that a ‘small aircraft, like a turbo-prop Cessna Caravan, will use $400 on conventional fuel for a 100-mile flight, says Mr Ganzarski. But with electricity "it'll be between $8-$12, which means much lower costs per flight-hour".' (Bowler, 2019)

Long haul flights are not feasible because of the huge gap in energy storage ability. Moreover, the cost of battery development is an expensive industry and is increasing in competitiveness drastically. However, hybrids are showing promise because the development of their technology will be easier to accomplish and more realistic based on the budget. Combining hybrids with short private flights which have a growing interest in the economy will be the most realistically optimal approach. After all, it is already being proven possible by brands like Eviation.

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