Thesis Project Portfolio

HEDGE
Hypersonic ReEntry Deployable Glider Experiment

(Technical Report)

Norway's Remarkable Adoption of Electric Vehicles

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

HEDGE: Hypersonic ReEntry Deployable Glider Experiment

Hypersonic flight occurs at speeds exceeding five times the speed of sound and is an expanding research field in the aerospace industry with military and civil applications. Military applications include hypersonic missiles, both offensive and defensive, and high-speed aircraft. Civil applications include access to space and commercial air travel. A CubeSat is a small satellite flown in low earth orbit that is well suited for undergraduate education. This technical project utilizes a CubeSat to in plans to perform a hypersonic glider flight experiment. These experiments are difficult to replicate in wind tunnels and expensive to achieve on rockets and aircrafts. By using a CubeSat, university students can conduct these experiments at a lower cost, and with greater accessibility.

This hypersonic glider mission follows two primary objectives: demonstrate the feasibility of CubeSats as a platform for hypersonic glider flight research and to demonstrate that undergraduate students can conduct hypersonic glider flight experiments at lower cost and with greater accessibility than traditional programs. This mission also has two secondary objectives: to provide an opportunity for undergraduates to gain firsthand experience and generate interest I the spaceflight industry and, finally, to collect and transmit sustained hypersonic flight data. These mission objectives align with those of NASA and the Department of Defense – both of which have shown growing interest in hypersonic research and the development of hypersonic systems.

This mission's design centers around the use of a traditional CubeSat modified aerodynamically to prolong hypersonic flight in extreme low earth orbit. The team has utilized the Space Mission Engineering process in the planning and execution of this mission thus far. Of

the fifteen involved students, five distinct teams have worked together and independently: Attitude Determination and Control Systems & Orbits, Communications, Software & Avionics, Power, Thermal & Environment, and Structures & Integration along with one team manager. Each sub-team performed cost/benefit analyses to determine optimal components for each system. A preliminary design of the spacecraft integrated those components. Analyses were performed to determine the optimal type and amount of thermal protective coating on the spacecraft for sustained flight ending in complete burnup in the atmosphere. The chosen components and development/manufacturing of the spacecraft combined for an estimated mission cost.

This year's work, as mentioned, has followed the Space Mission Engineering process, and has culminated in a Conceptual Design Review presentation to NASA and to the mission advisor as well as a Formal Final Proposal Deliverable to NASA. The presentation included a 3D-printed model of the spacecraft to demonstrate design decisions and overall feasibility.

Norway's Remarkable Adoption of Electric Vehicles

Our way of life is putting the planet, the environment in jeopardy. Worldwide, vehicle emissions account for one sixth of greenhouse gas emissions. Electric vehicles pose a potential component in lowering transportation's carbon footprint. In Norway, electric vehicle sales have been rising exponentially since the early 1990s. Electric vehicles accounted for two-thirds of new vehicle sales, yet elsewhere electric vehicles are struggling to gain traction or legitimacy in consumers' eyes.

Electric vehicles produce fewer greenhouse gas emissions than internal combustion engine vehicles and they are simpler and cheaper to operate as they have fewer moving parts. Despite their benefits, electric vehicles have a low take rate in the developed world. Range

anxiety, steep prices, lacking infrastructure, etc. are hinderances to the widespread acceptance of electric vehicles. The Norwegian Parliament's success story in electric vehicle adoption is one involving cultural shifts and socioeconomic incentives – it can serve as a template for the rest of the world. Norway's adoption of electric vehicles proves the notion that government intervention is necessary to push green transportation to consumers and avoid the most severe effects of climate change. Allowing the shift to green transportation to occur naturally through social networks and peer effects would take too long.

Still, the key to a less carbon intensive future in transport involves more than just electric vehicles. Norway's success is a result of Norway's distinctive circumstances – Norway's abundance of clean domestic energy, Norwegian's collective wealth from the nationalized oil industry – Norway's methods are not necessarily applicable everywhere. Adopting simpler, greener transportation options is possible everywhere though. Options such as bicycling or clean mass transit are vital as electric vehicles are prohibitively expensive for many, require sweeping infrastructure development and produce emissions during production, disposal, and material sourcing.

Norway's story is imperfect in that electric vehicles are an imperfect solution to the transportation problem, but Norway's story still exemplifies successful, if incomplete, transportation reform for tomorrow. The world's developed nations ought to follow a modified version of Norway's example, emphasizing overall low carbon transportation, through incentives and reformation of social norms.