

Thesis Project Portfolio

Hybrid-Electric Regional Turboprop

(Technical Report)

The External Factors of Internal Combustion

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My capstone research addresses the 2023 AIAA Request for Proposal, describing a hybrid-electric regional turboprop aircraft that satisfies various requirements, including a 20% reduction in block fuel burn. Our design makes use of parallel-hybrid technology with two wingtip propulsors powered by electricity from a battery during taxi, takeoff, and climb, and cruise power being provided by jet fuel. It is important to consider the human and social dimensions of this technology as it affects not only aviation but also the environment and society as a whole. Our aircraft has the potential to reduce emissions and noise pollution, but it requires changes in infrastructure, regulations, and social attitudes. Indeed, it represents a tangible step in improving the sustainability of air travel, which has long been decried as an environmental disaster. Some theories that may be useful in our analysis include technological momentum and actor-network theory. Regarding technological momentum, it may be difficult to envisage the electrification of aircraft propulsion systems given the obstacles it would encounter. Weight penalties, FAA regulations, and infrastructure adaptation would all be necessary to implement our concept. Actor-network theory would help to explain society's dependency on aircraft as well as its need for an increase in their sustainability, which in turn would help to explain the need for the technology we have designed.

For my STS research, I interviewed individuals who I consider to be experts in relevant areas of my question, and who I knew would provide me with profound, interesting, and unique responses to my questions. Additionally, I conducted a literature search to better educate both my interviews and my own knowledge and considerations in answering my STS question. I also investigated the socio-technical systems that support or hinder the transition to alternatives to internal combustion. Through my STS research, I have found that the future of internal combustion engines is highly contested and influenced by various factors, including technological, economic, and political factors. Different stakeholders have different visions and preferences for the future. Ultimately, rather than completely replacing the ICE, engineers may seek instead to reduce its impact on the environment in various ways currently under investigation. The implications of my capstone project and STS research combined highlight the complex

and dynamic interactions between technology, society, and the environment. My capstone work represents a promising lodestar for sustainable aviation, but its success depends on the social acceptance and integration of new technologies. Similarly, the future of internal combustion engines is not only a technical issue but also a socio-political issue that requires engagement and collaboration across various sectors and perspectives.