Project Update 10/22/2024:

In April 2024, the Illinois Space Society's Hybrid Propulsion Project hit an incredible milestone: a successful hot-fire test of our hybrid rocket engine. This moment was years in the making, the result of nearly eight years of hard work, innovation, and persistence. It's been an intense cycle of designing, building, testing, and refining—a true team effort to push forward the potential of hybrid propulsion at the collegiate level.

After our initial success, we didn't stop. The team conducted a second hot-fire test the following semester, with even better results. The engine delivered higher thrust and impulse, coming closer to our theoretical maximum. These follow-up tests have shown us that our design isn't just feasible—it's capable of real, repeatable performance. Every aspect of the engine is being fine-tuned to make it as efficient, reliable, and safe as possible.

Our hybrid engine is designed to offer a more sustainable alternative to traditional solid or liquid rockets, which often use hazardous propellants and can have significant environmental impacts due to emissions and one-time-use designs. Our setup uses a mix of nitrous oxide and oxygen as oxidizers, combined with pure paraffin wax as the solid fuel. Paraffin, the same material used in candles, is a low-risk and low-impact fuel. Meanwhile, our choice of oxidizers makes our system inherently safer because the fuel and oxidizer stay separate until ignition, reducing storage and handling risks. Together, these choices align with our goal to make rocketry more eco-friendly.

Now that we've seen what the engine can do, we're shifting our focus to the next challenge: integrating it into a reusable launch vehicle. This isn't just about launching a rocket. We want to build a vehicle that can withstand the rigors of launch, complete its mission, and then safely return for reuse. Recoverable rockets are a big part of reducing space debris and cutting down on material waste, and they align perfectly with our team's sustainability goals.

Moving into this new phase, we're encountering new challenges—designing recovery systems, figuring out parachute deployment, handling avionics, and setting up real-time telemetry. Each of these elements needs to work seamlessly to ensure the rocket can return safely for another mission.

For all of us involved, this project has been an incredible hands-on learning experience that goes beyond anything we could get in the classroom. From freshmen just starting out

to seniors about to graduate, everyone on the team has had the chance to engage deeply, from designing on paper to testing in the field. These experiences are giving us skills that will be essential in our careers and helping us see how innovation can align with environmental responsibility. Members from hybrid have gone on to be engineers at companies like SpaceX, Blue Origin, Northrop Grumman, and many more aerospace companies.

This project has also brought together students from a wide range of fields—mechanical engineering, computer science, electrical engineering, chemical engineering—showing that sustainable rocketry requires a truly multidisciplinary approach. Since this project isn't restricted by ITAR regulations, even international students have been able to participate, bringing a diversity of perspectives.

None of this would have been possible without the support of the Student Sustainability Committee (SSC) and other contributors. Their backing has made these technical advances possible and inspired countless students to consider the environmental impacts of their work in aerospace.