Constraint Essay – OMID USA: Organic Photovoltaic Canopies for Agrivoltaics

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Our senior design project focuses on developing AI-driven organic photovoltaic (OPV) canopies that can simultaneously generate renewable energy and support healthy crop growth. Several constraints influence how we design, prototype, and validate our solution. Economic constraints play a major role because OPV fabrication and testing are expensive, and our team relies on open-source simulation tools and university computing resources rather than paid platforms. Limited funding restricts large-scale prototyping, so we must prioritize efficient material selection and low-cost modeling approaches. Environmental constraints also guide our design decisions since the canopies will operate outdoors in agricultural settings; the chosen OPV materials must be non-toxic, weather-resistant, and recyclable to ensure minimal ecological impact. Additionally, our canopy geometry must optimize light transmission to crops without reducing their growth or soil quality. Ethical and social constraints arise because our system directly affects farming communities—our design must enhance agricultural productivity without displacing labor or creating inequality in access to green technologies. We aim for transparency in data use and open collaboration to promote global adoption in developing regions. Professional and legal considerations include respecting intellectual-property rights when using existing OPV polymer datasets and published material structures. We must also follow proper citation and licensing standards when integrating AI frameworks and published datasets into our workflow. Finally, security and data-privacy constraints affect how we store and share our AI models and simulation data through GitHub and cloud services. Together, these constraints ensure that our final design remains technically robust, economically viable, environmentally sustainable, and socially responsible.

Summary

Together, these constraints ensure that our final design remains:

- **Technically robust**
- **Economically viable**
- **Environmentally sustainable**
- **Socially responsible**
- **Culturally inclusive**