

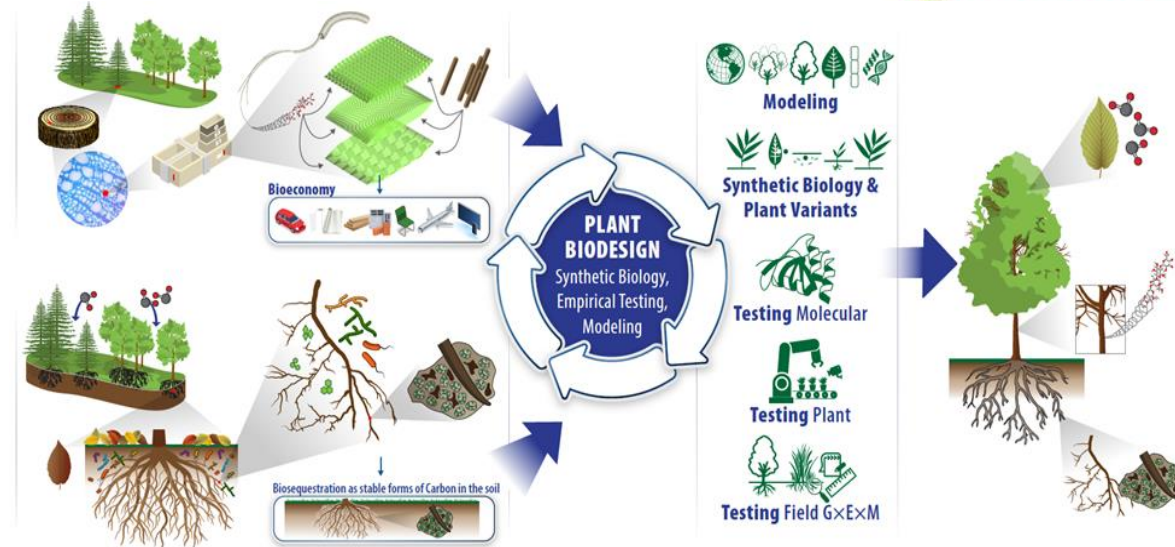
Plant Biosystems Design for a Carbon-neutral Bioeconomy

Background

- Development of bio-based solutions towards climate change mitigation, efficient production of fuels and materials, and enabling a sustainable bioeconomy has high merits and desirability.

Approach

- This perspective discusses transformative biosystems design strategies required to simultaneously optimize above-ground plant tissues (stem/leaf) for biofuels and biomaterials, and belowground systems (root and soil) for carbon storage, including:



Plant biosystems design strategies for enabling a carbon -neutral bioeconomy

- Expand fundamental biological knowledge based on plant carbon capture, allocation, partitioning, release and storage processes.
- Identify and evaluate pathway control knobs (genes/promoters) underlying short- and long-distance communication/transport and trait-tradeoffs across hierarchical scales of biological complexity.
- Develop community-curated synthetic biology toolboxes of theory, parts, and principles to enable precise and secure co-optimization.
- Development and integrate of automation, robotics, artificial intelligence, and predictive modeling-based approaches for higher-throughput and efficacy in design-build-test-learn cycles.

Impact

- Accelerated simultaneous development of cultivars and genotypes to maximize land-use efficiency, enhance crop productivity, optimize chemistry and enable a carbon-neutral bioeconomy.
- Deployment of the plant-based carbon biosequestration and plant-derived materials concept will require convergence of perspectives from research, industrial, government, and consumer sectors.