New Feed Sources Key to Ambitious Climate Targets

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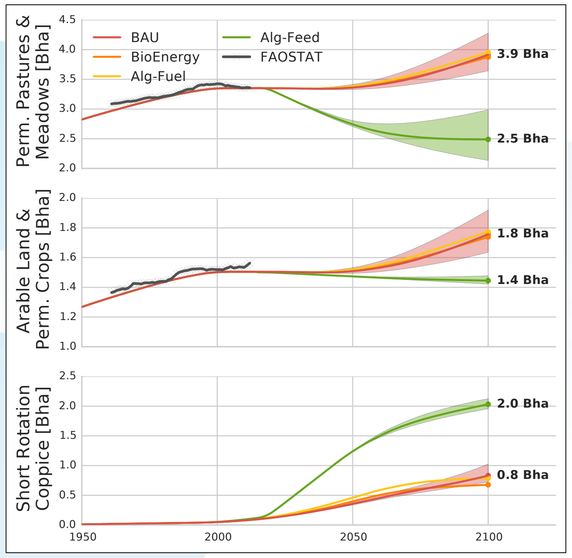
Looming Challenges

- **Climate Change:** to limit warming below 2C, net emissions must be reduced to zero by 2075.
- **Protein Shortfall:** economic & demographic growth combine to increase vegetal (+80%) and animal food demand (+120%) by 2100.
- **Land Scarcity:** food demand growth could outstrip agricultural intensification, driving land use change and exacerbating emissions & biodiversity loss.
- **Water Scarcity**: climate change and agricultural intensification will drive expansion of irrigation, depleting aquifers.
- **Nutrient Cycling:** agricultural runoff and other wastewater drive eutrophication and pollute surface and ground water.

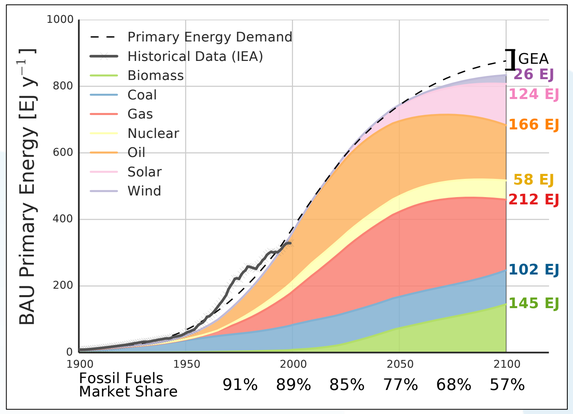
Algae as Feedstock

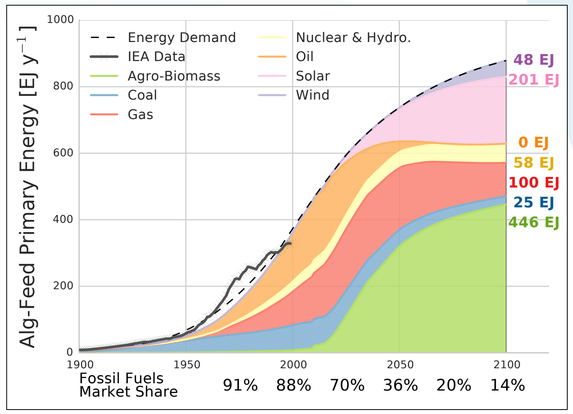
- **Huge Productivities:** up to 150 tDM/ha/y in closed systems
- **Minimal Resource Loads:** can be produced on degraded or unproductive land in salt and brackish water with flue gas and waste water.
- **Good for Animals:** demonstrated up to 45% of ruminant diets without effect on feed palatability, animal growth, or mortality.
- **Great Value:** meeting 40% of feed demand in 2013 would have cost 250-920 B$US ($500 – $1840 / tDM).
- For comparison, global fossil fuel subsidies were 550 B$US in 2013.
- Algae closes critical carbon, water, and fertilizer cycles and therefore **avoids the tradeoffs and problem shifting we see with other biofuels**



Land Use & Energy

Using microalgae to meet 40% of global animal feed demand (2010: 0.5 Gt/y; 2100: 1.0 Gt/y) would free almost 2 Bha of arable land, which could be used for energy crop production.





Algal feedstock can free the arable land necessary to transform the energy and land use sectors into net carbon sinks, precipitating returns to preindustrial atmospheric carbon levels and temperatures by 2100.