Nitrogen Technologies: Large Scale Carbon Producer

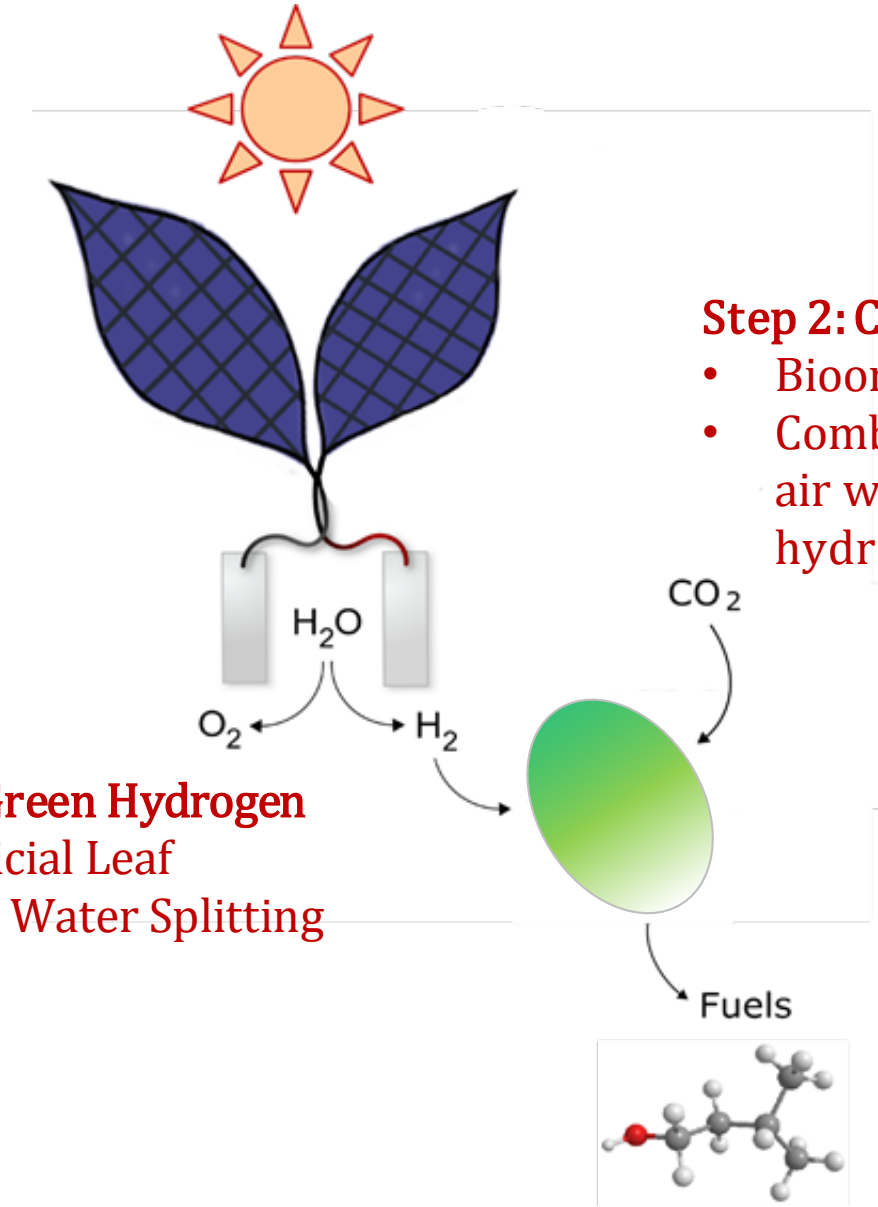
Nitrogen Fixation Important as an Energy and Food Target

$$N_2(g) + 1.5CH_4 + 1.5O_2 \rightarrow 2NH_3(aq) + 1.5CO_2(g)$$

Haber-Bosch process:

- Energy intensive: 1~2% world energy supply
- High CO_2 emission: 3~5% world natural gas use

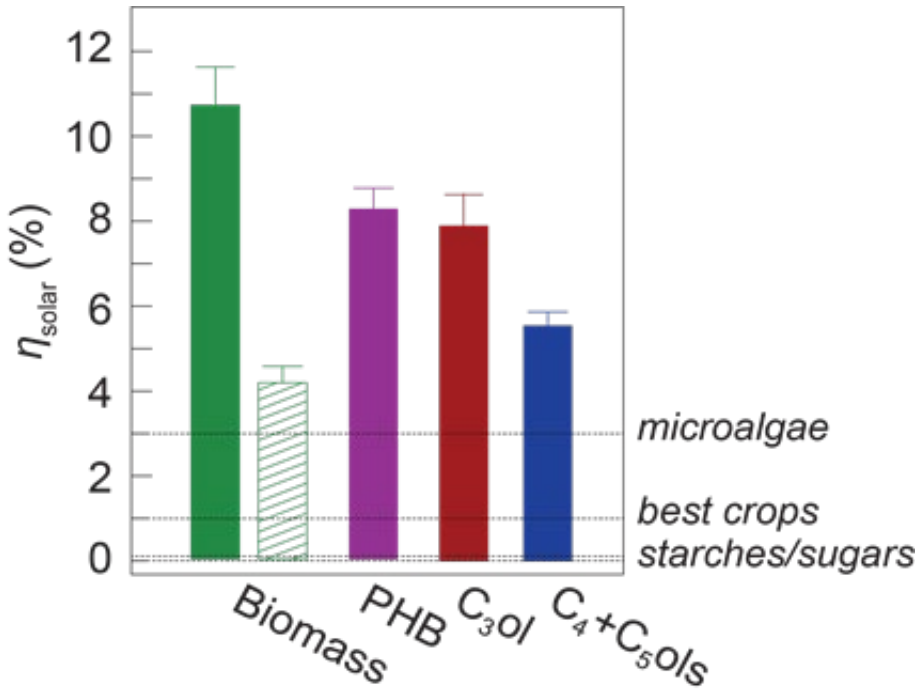
Bionic Leaf 1
(Water Splitting + Carbon Fixing Organisms)



Step 1: Green Hydrogen
- Artificial Leaf
- Solar Water Splitting

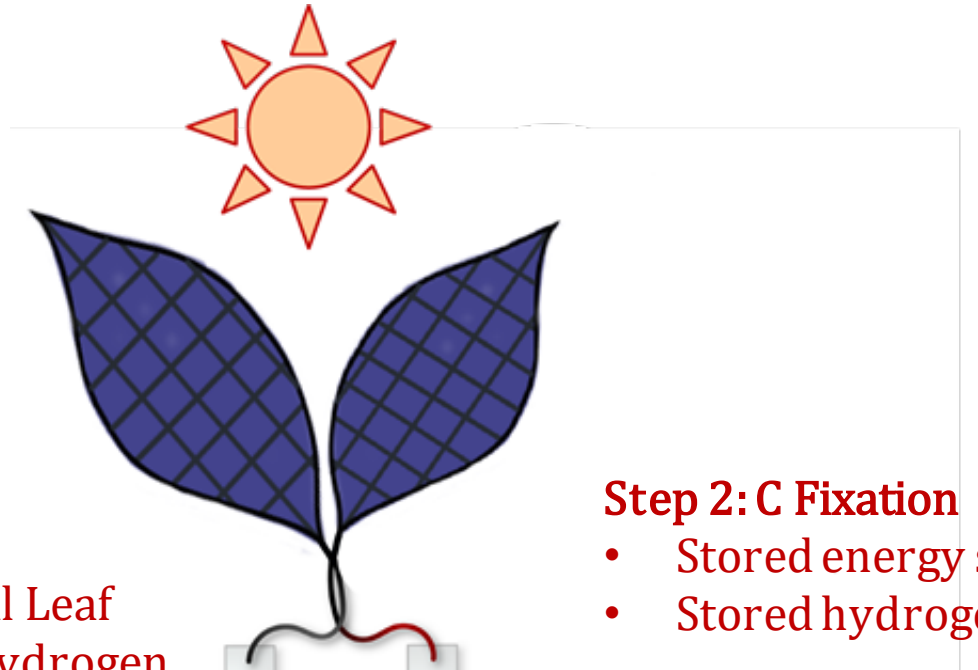
Step 2: C Fixation
- Bioorganism
- Combines CO_2 from air w/green hydrogen

Ten Times Better than Natural Photosynthesis



Bionic Leaf N (Fertilizer)

(Water Splitting + Carbon/Nitrogen Fixing Organisms)

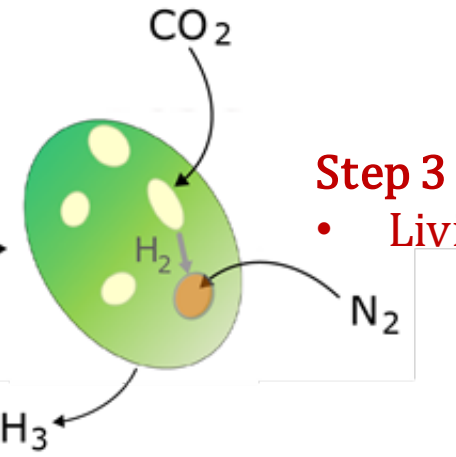


Step 1

- Artificial Leaf
- Green hydrogen

Step 2: C Fixation

- Stored energy supply
- Stored hydrogen supply



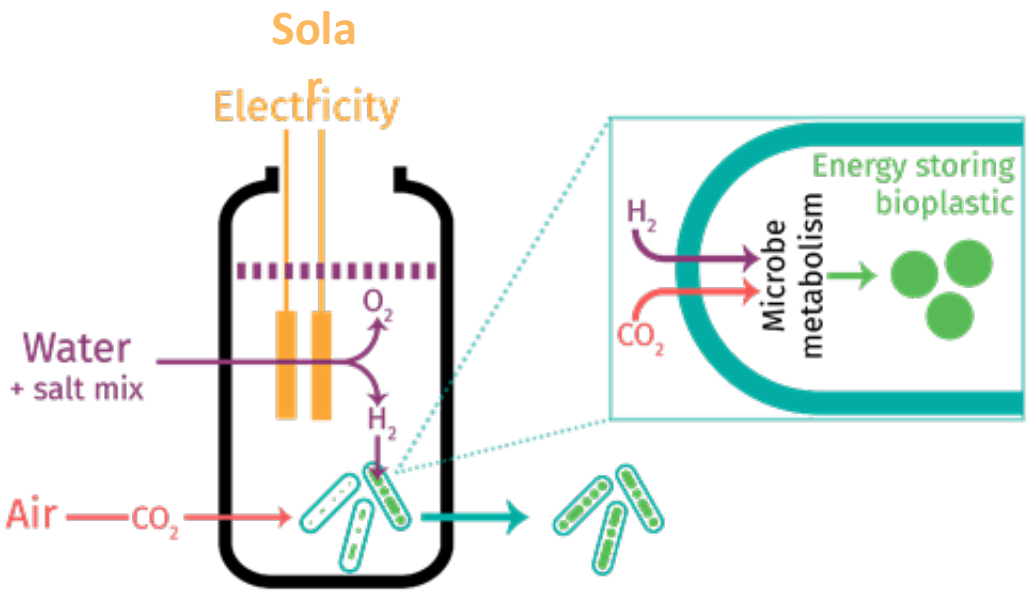
Step 3 : N Fixation

- Living biofertilizer

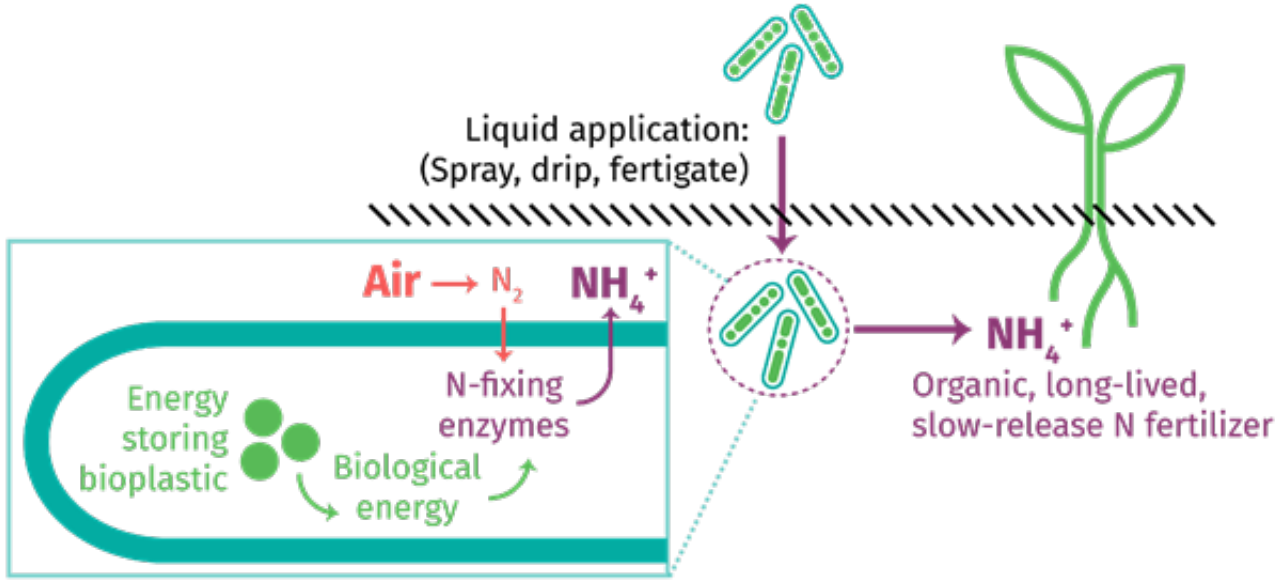
(organic fertilizer)

Bionic Leaf N Process

Steps 1 and 2: (1) Split Water (Artificial Leaf) and (2) Fix H_2 with CO_2 to Make Internal Cellular Energy Supply for Microbes



Step 3: Microbe Uses Stored Energy and Hydrogen to Make Ammonia

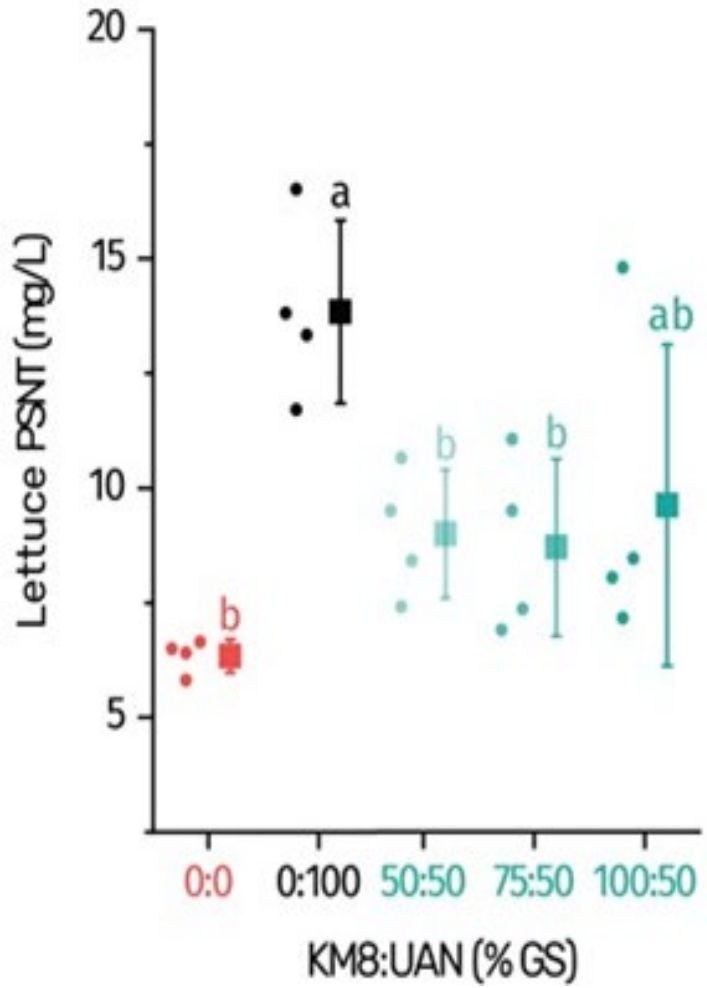


Nitrogen fixation is an energy intensive process:

$$N_2 + 8H^+ + 16ATP + 8e^- \rightarrow 2NH_3 + H_2 + 16ADP + 16P_i$$

This approach circumvents down regulation

Lettuce and Sweet Corn (130 lb N /acre)



)% chemical fertilizer

90% chemical fertilizer

Sequester 29K lb CO_2, Eliminate 225K lb CO_2
Carbon Savings = 253,000 lb CO_2

KM8 sequesters 29,000 lb CO_2

KM8 CO_2 sequestration per lb N
−1.105 lb CO_2 / lb N

Total annual farm N demand
26,000 lb N / year

1 farm using KM8 = −29,000 lb sequestered CO_2

H-Bosch emits 225,000 lb CO_2

H-Bosch CO_2 emissions per lb N
+4.2 lb CO_2 / lb N

Total annual farm N demand
26,000 lb N / year

1 farm using Haber-Bosch = 225,000 lb emitted CO_2 + runoff & NO_x

Note: Assumes 400-acre farm with 130 lb N/acre demand for 26,000 lb N farm demand