About OMICS Group

OMICS Group International is an amalgamation of Open Access publications and worldwide international science conferences and events. Established in the year 2007 with the sole aim of making the information on Sciences and technology 'Open Access', OMICS Group publishes 400 online open access scholarly journals in all aspects of Science, Engineering, Management and Technology journals. OMICS Group has been instrumental in taking the knowledge on Science & technology to the doorsteps of ordinary men and women. Research Scholars, Students, Libraries, Educational Institutions, Research centers and the industry are main stakeholders that benefitted greatly from this knowledge dissemination. OMICS Group also organizes 300 International conferences annually across the globe, where knowledge transfer takes place through debates, round table discussions, poster presentations, workshops, symposia and exhibitions.

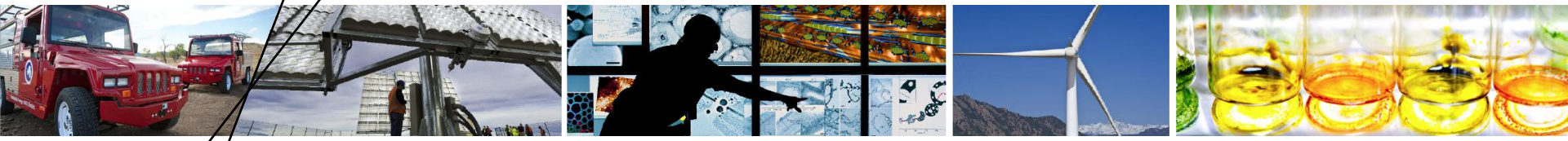
About OMICS Group Conferences

OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Pharma scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bengaluru and Mumbai.

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Photosynthetic Ethylene Production in a Cyanobacterium



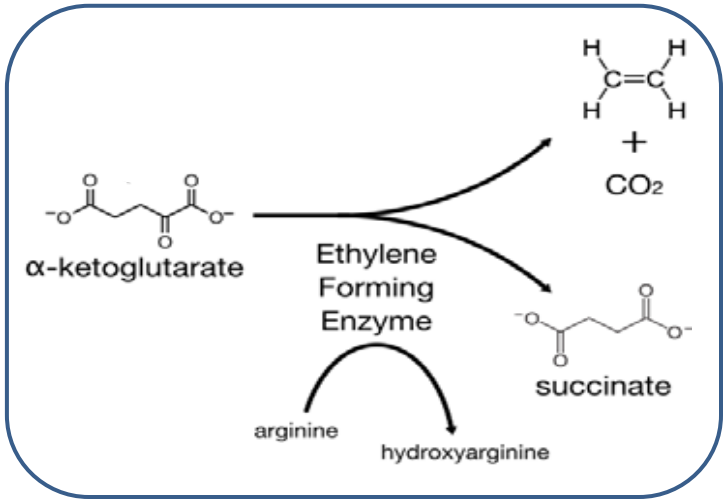
Jianping Yu

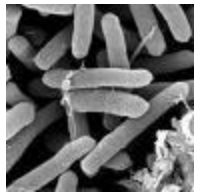
April 1, 2014

Biological Ethylene Production

- Regulates many processes in plant growth
- Plant pathogens use ethylene as a weapon to weaken plant defense.
- **Ethylene forming enzyme (EFE)**; present in *Pseudomonas syringae*

… powerful plant hormone



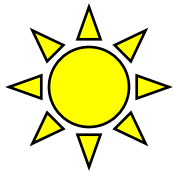


Ethylene-forming Enzyme (EFE)

- Found initially from green mold *Penicillium digitatum*.
- The mold uses ethylene to trigger self-degradation of fruit tissue (pretreatment + hydrolysis), and uses penicillin to fend off competitors.
- EFE is a 40kD protein in the Fe-II AKG-dependent oxygenase/hydroxylase super family.
- No 3-D structure; poorly understood mechanism.
- EFE from plant pathogenic bacterium *Pseudomonas syringae* pv Kudzu has higher activity, and has been explored for bioethylene production.

- Eckert et al., Biotechnology for Biofuels, 2014

Cyanobacteria can produce ethylene



CO_2 in air →  → Ethylene → Measured by GC

Problem with previous research:
Genetic instability in *Synechococcus* 7942.

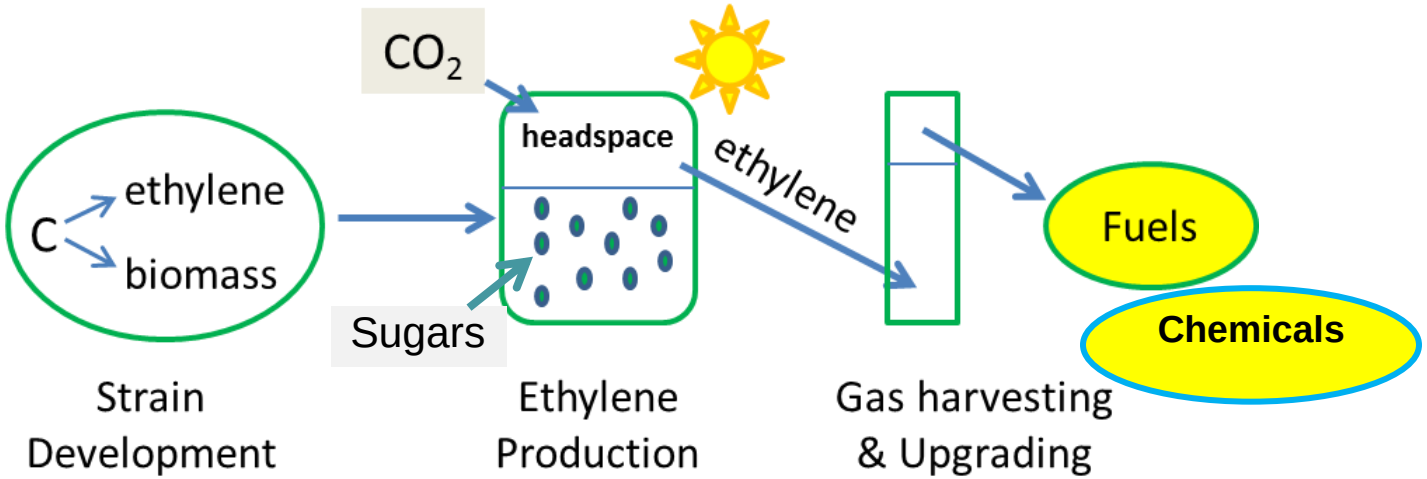
Goals

To develop a photosynthetic ethylene production technology using cyanobacteria. This technology is at early stage of development and has potential to produce biofuels and green chemicals

(1) at higher areal productivity than terrestrial plants;

(2) not competing with agriculture for arable land and fresh water;

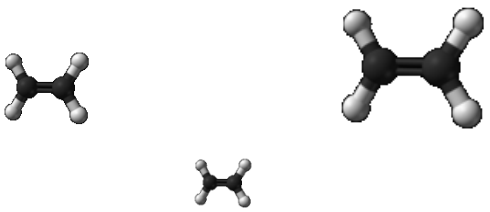
(3) as a component of an integrated biomass conversion system to use the CO_2 from fermentation, as well as biomass sugars.

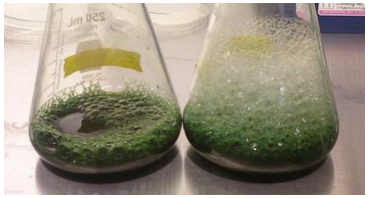


Current focus

Photosynthetic Ethylene Production
The Ethylene Advantage

- Ethylene is the most produced organic compound world wide. Infrastructure for ethylene utilization is already in place.
- Versatile feedstock for fuels, plastics, and chemicals.
- Ethylene is a gas, can be harvested directly from the headspace of photobioreactor, saving cost and energy in harvesting and extraction compared to algal lipids production.
- Direct, aerobic, continuous CO_2 /sugars to ethylene conversion.
- Not a food source for common microbes; reduces feeding and contamination problems.
- No toxicity to the microbe thus could afford higher productivity.





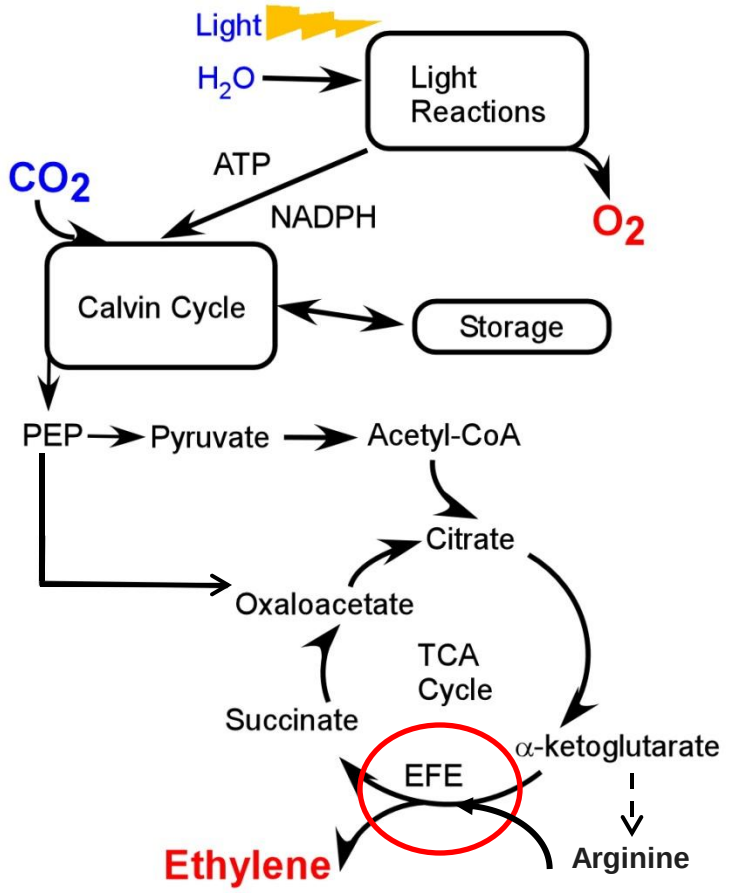
Synechocystis sp. PCC 6803 "green *E. coli*"

…easiest organism to transform

- High photosynthetic efficiency
  - Multiple light harvesting pigments
  - CO_2 concentrating mechanism
- Excellent genetics
  - Introduce foreign genes
  - Remove native genes
  - Control gene expression levels
  - Change gene/protein sequences

- NREL research projects
  - Photosynthesis and carbon metabolism
  - organic acids production
  - Ethylene production
  - Hydrogenase and H_2 production

Synbio Tool Development to Enhance EFE Activity



Re-design *efe* gene

↓ gene stability

Stronger promoter

↓ transcription

Multiple *efe* copy

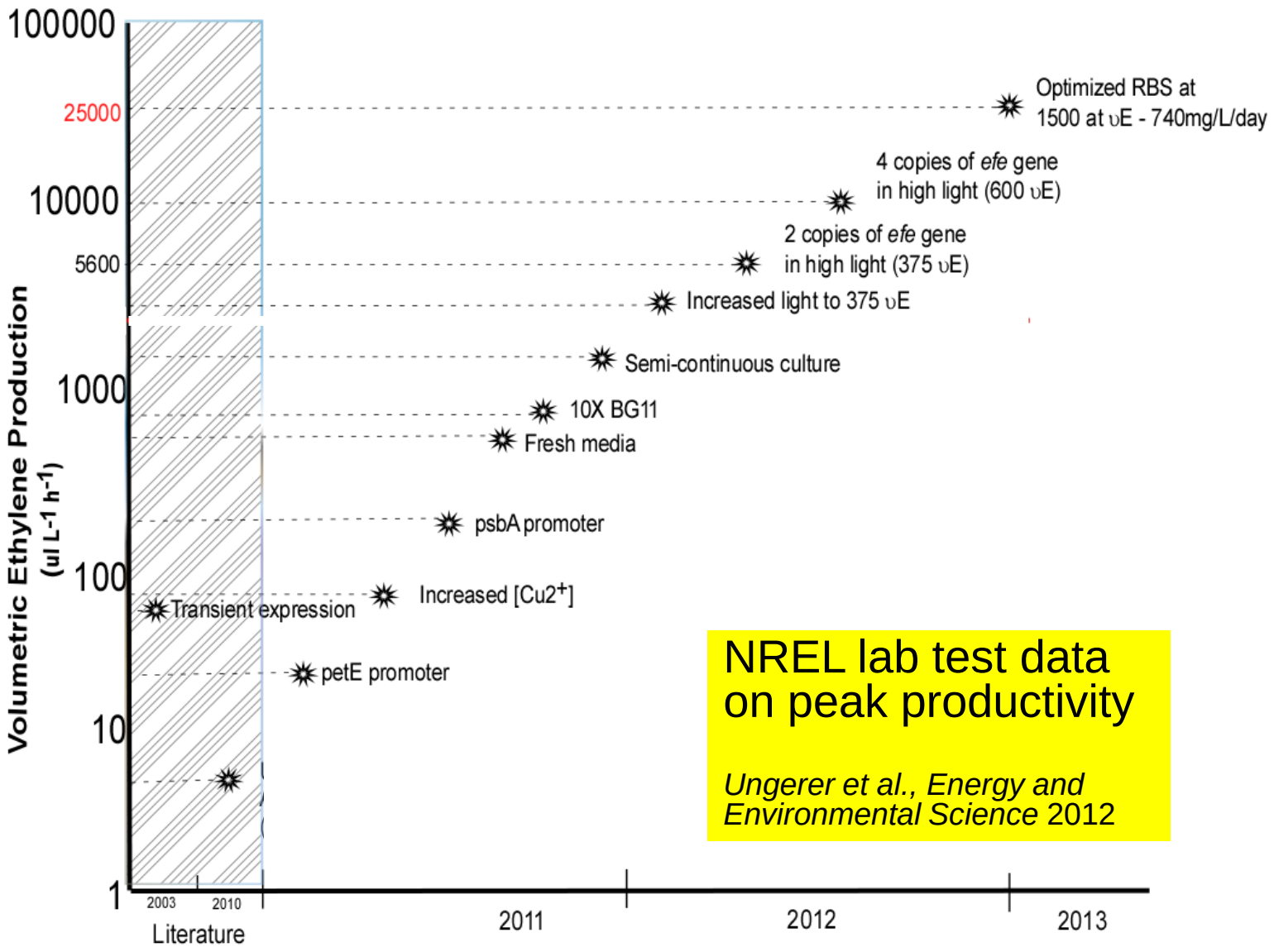
↓ gene dosage

Stronger ribosome binding site (RBS)

↓ translation

Enhanced EFE synthesis

Progress of Bioethylene Research



NREL lab test data on peak productivity

Ungerer et al., Energy and Environmental Science 2012

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