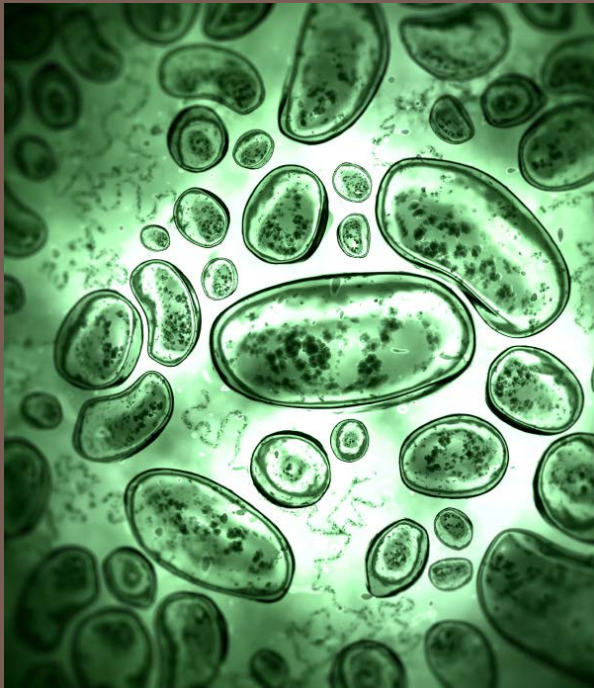


SYNTHETIC BIOLOGY: WHAT IS IT? SHOULD WE BE CONCERNED?



June 5, 2013

Coming Clean Collaborative

Eric Hoffman

Food & Technology Policy Campaigner

Friends of the Earth U.S.

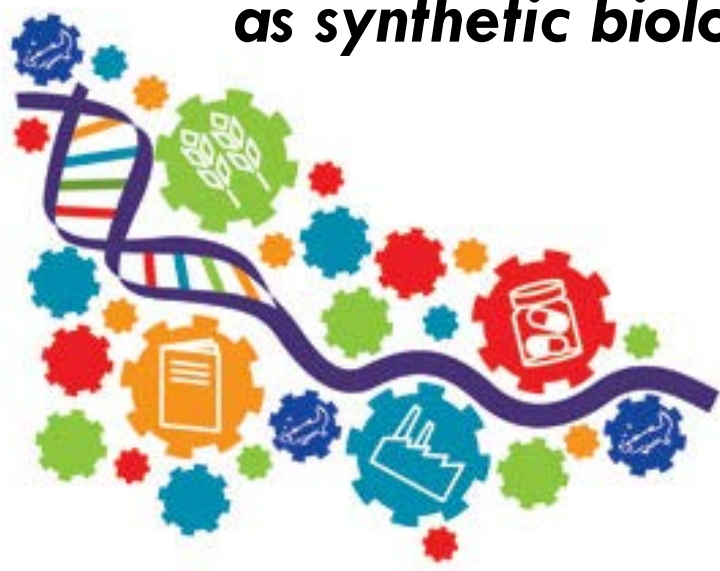
The Bioeconomy & Synthetic Biology

2

*“Imagine a world in which there are “ready to burn” liquid fuels produced directly from CO₂, biodegradable plastics made not from oil but from renewable biomass, tailored food products to meet specialized dietary needs...**Tomorrow’s bioeconomy relies on the expansion of emerging technologies such as synthetic biology...** as well as new technologies as yet unimagined.”*

– White House National Bioeconomy Blueprint

April 2012





Synthetic Biology:

“Extreme” Genetic Engineering”

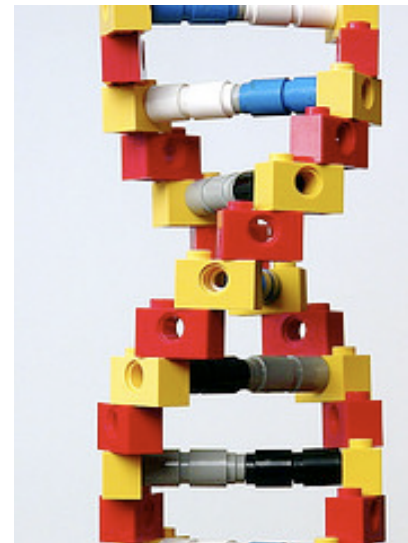
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- “Old” Genetic Engineering - moving one or two genes from one organism into another organism.
- Synthetic Biology - writing new genetic code and biological “circuits”
- Increased complexity:
 - ▣ Genetic engineering – a few genes
 - ▣ Synthetic biology - over a million base pairs for the first genome copied

Distinct Approaches/Sub-Fields

4

- DNA synthesis
- “Bibricks”
- Minimal genomes
- Whole genome engineering
- Xenobiology
- “Protocells”



The promise? (The hype?)

5

- Biofuels
- Industrial chemicals
- Bioplastics
- Natural product replacements
- Biomedical applications



Market Size for Synthetic Biology?



← 2008: \$233.8 million



← 2013: \$2.4 billion

2015: \$4.5 billion



Outdated regulations & risk assessment frameworks

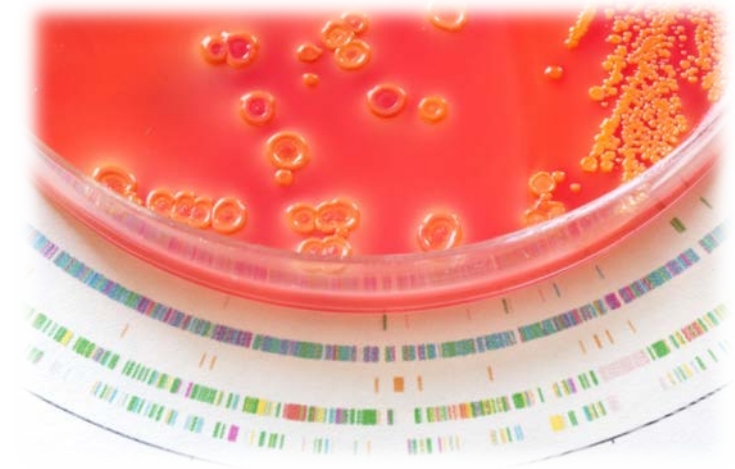
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- Biotech regulations quickly becoming outdated
- **ZERO risk assessments on ANY synthetic organism**
- Risk assessment models for “old” genetic engineering difficult to apply to novel risks
- Between 2005 – 2010, US government spent \$430 million on synthetic biology related research – **ZERO spent on environmental risk assessment**⁵

Unpredictability of Risks

8

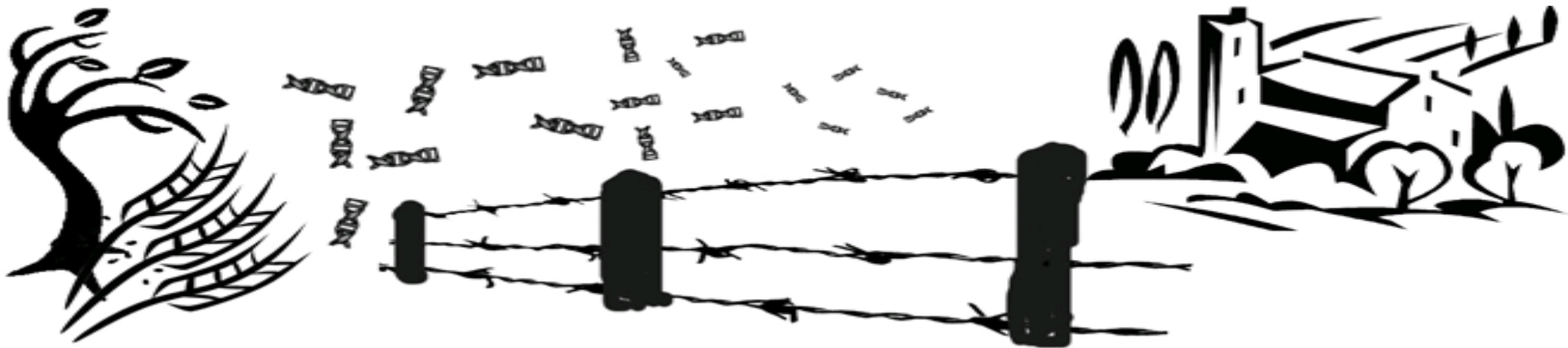
- Novel genes, novel traits, novel organisms
- Creation of hundreds of thousands of novel synthetic organisms at once
- Ability to synthesize new genes far outpacing understanding of how they work



Environmental Risks

9

- Unintentional or intentional environmental release
- Genetic contamination
 - ▣ Gene transfer common: yeast, *E. coli*, viruses, algae,
 - ▣ Impossible to clean up,
 - ▣ Dead organisms can pass on DNA to wild relatives²
- New invasive species³
- New pollutant



The New “Bio-Economy”?

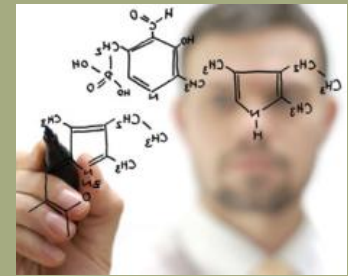


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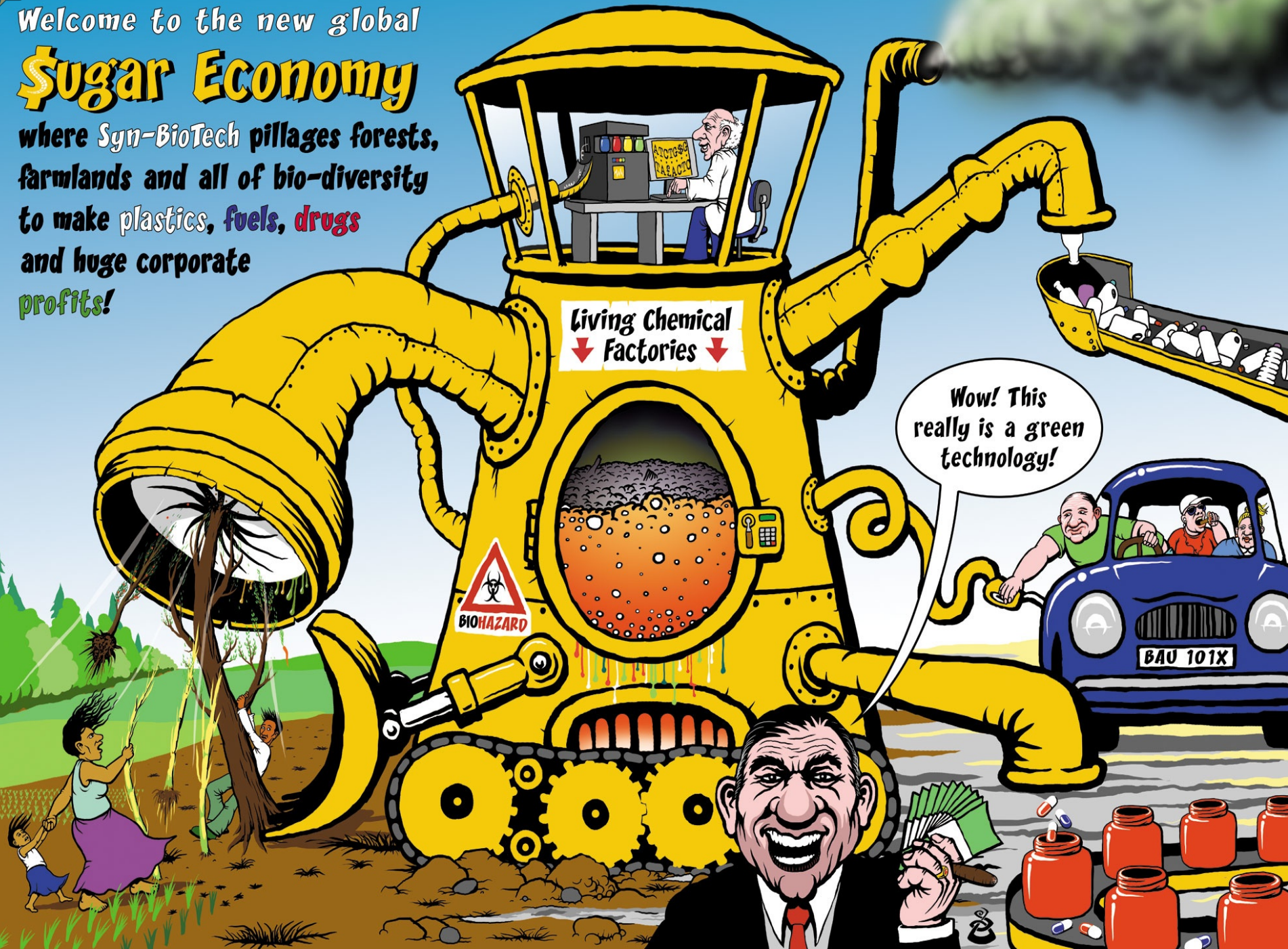
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Welcome to the new global

\$ugar Economy

where Syn-BioTech pillages forests, farmlands and all of bio-diversity to make plastics, fuels, drugs and huge corporate profits!



Living Chemical
Factories



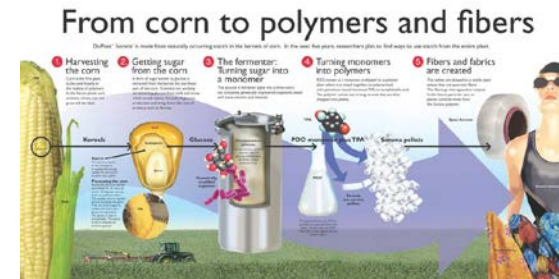
Wow! This really is a green technology!

BAU 101X

A whole lot of biomass...

12

□ DuPont: 40,000 acres of corn annually into 100 million pounds of plastic (Nearly the size of DC)



□ Mascoma: 71,000 acres of timber annually to produce 40 million gallons of ethanol (1.6x size of DC)

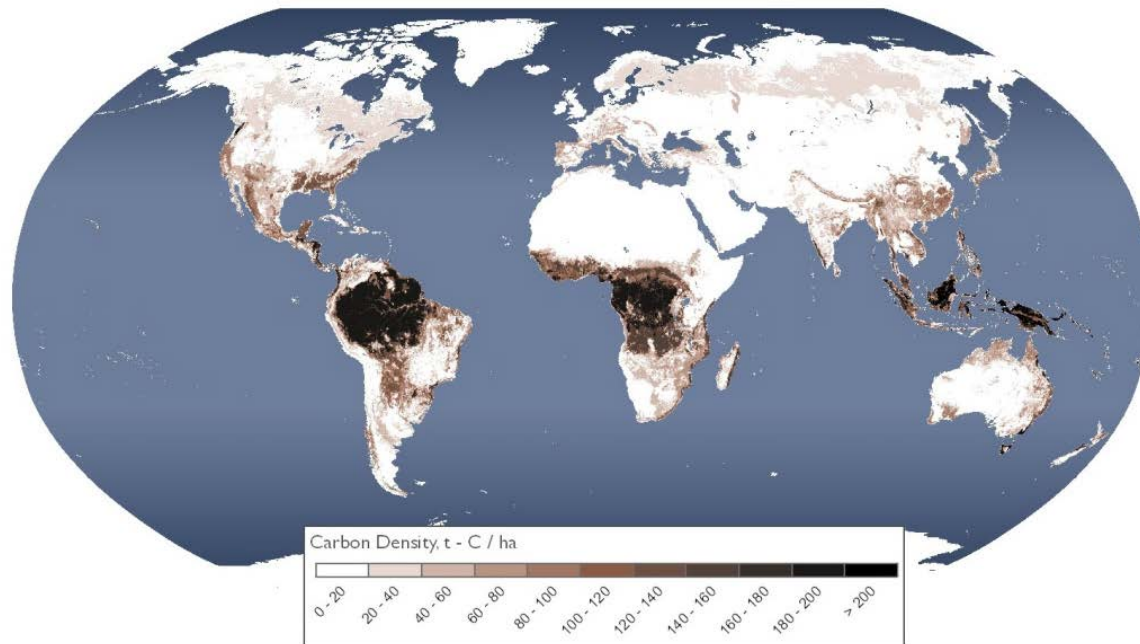


Combined = 2.5x size of Washington, DC!

Where is All the Biomass?

13

Global Above- and Below-ground Living
Biomass Carbon Density



“If you look at a picture of the globe .. Its pretty easy to see where the green parts are and those are the places where one would perhaps optimally grow feedstocks”

- Steve Koonin US Dept of Energy (formerly BP)

Thank You

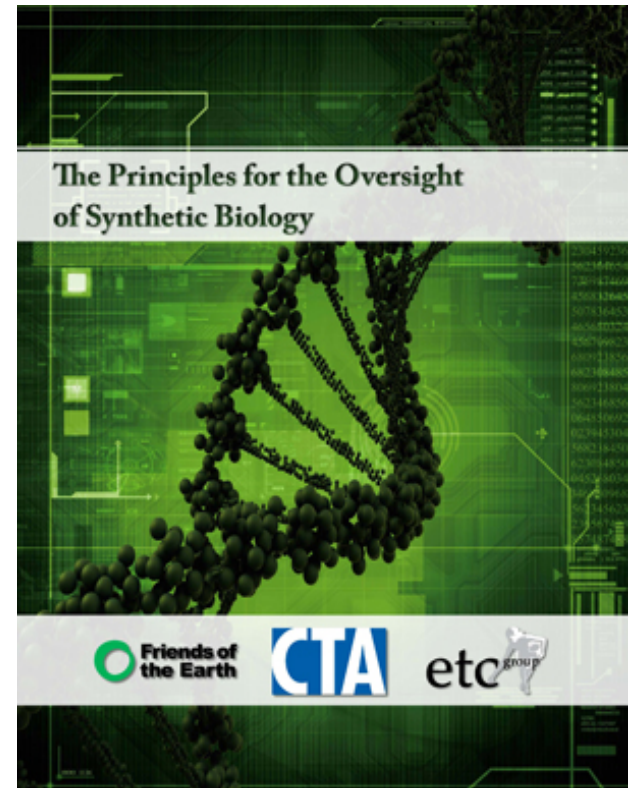
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