



May 26, 2010

The Honorable Henry Waxman
Chairman
Committee on Energy and Commerce
2125 Rayburn House Office Building
United States House of Representatives
Washington, D.C. 20515

The Honorable Joe Barton
Ranking Member
Committee on Energy and Commerce
2109 Rayburn House Office Building
United States House of Representatives
Washington, DC 20515

Offering Testimony from Civil Society on the Environmental and Societal Implications of Synthetic Biology

Dear Representatives,

We are writing on behalf of international civil society organizations who for some years have been engaged in tracking developments in Synthetic Biology and analyzing the societal and environmental impacts of this emerging technological platform.¹ We understand that on Thursday May 27, 2010 the U.S. House of Representatives Energy and Commerce Committee will hold a hearing on recent developments in synthetic biology and its implications for health and energy. We respectfully request that the committee consider the following testimony as a critical contribution to your work on this matter. We also ask that the committee consider holding a further hearing on this matter so that the voices of those in civil society who have long been concerned about the environmental, public health and socio-economic impacts of synthetic biology as a field can be heard in this hearing process.

We note that this hearing comes immediately before another hearing dealing with the unfolding BP oil spill in the Gulf of Mexico. With this in mind, we urge representatives to consider the importance of asking hard questions about the threats of new experimental technologies *before* they are deployed, not after terrible accidents have already occurred.

Wake up call – time for a pause:

Last week, the J. Craig Venter Institute announced the creation of the first living organism with a synthetic genome claiming that this technology would be used in applications as diverse as next generation biofuels, vaccine production and the clean up of oil spills. We agree that this is a significant technical feat however; we believe it should be received as a wake-up call to governments around the world that this technology must now be accountably regulated. While attention this week has been on the activities of a team from Synthetic Genomics Inc, the broader field of synthetic biology has in fact quickly and quietly grown into a multi-billion dollar industry with over seventy DNA foundries and dozens of ‘pure play’ synthetic biology companies entering the marketplace supported by large investments from Fortune 500 energy,

forestry, chemical and agribusiness companies. That industry already has at least one product in the marketplace (Du Pont's 'Sorona' bioplastic), and another recently cleared for market entry in 2011 (Amyris Biotechnology's 'No Compromise' biofuel) as well as several dozen near to market applications. We believe the committee should consider the implications of this new industry as a whole in its deliberations not just the technical breakthrough reported last week. Without proper safeguards in place, we risk introducing synthetically constructed living organisms into the environment, intentionally or inadvertently through accident and worker error, that have the potential to destroy ecosystems and threaten human health. We will see the widespread commercial application of techniques with grave dual-use implications. We further risk licensing their use in industrial applications that will unsustainably increase the pressure of human activities on both land and marine ecologies through the increased take of biomass, food resources, water and fertilizer or displacement of wild lands to grow feedstocks for bio-based fuel and chemical production.

We call on Congress to:

- 1) Implement a moratorium on the release of synthetic organisms into the environment and also their use in commercial settings. This moratorium should remain in place until there is an adequate scientific basis on which to justify such activities, and until due consideration of the associated risks for the environment, biodiversity, and human health, and all associated socio-economic repercussions, are fully and transparently considered.
- 2) As an immediate step, all federally funded synthetic biology research should be subject to a comprehensive environmental and societal impact review carried out with input from civil society, also considering indirect impacts on biodiversity of moving synthetic organisms into commercial use for fuel, chemicals and medicines. This should include the projects that received \$305 million from the Department of Energy in 2009 alone.
- 3) All synthetic biology projects should also be reviewed by the Recombinant DNA Advisory Committee.

On synthetic biology for biofuels - time for a reality check.

Much of the purported promise of the emerging Synthetic Biology industry resides in the notion of transforming biomass into next generation biofuels or bio-based chemicals where synthetic organisms work as bio-factories transforming sugars to high value products. On examination much of this promise is unrealistic and unsustainable and if allowed to proceed could hamper ongoing efforts to conserve biological diversity, ensure food security and prevent dangerous climate change. The sobering reality is that a switch to a bio-based industrial economy could exert much more pressure on land, water, soil, fertilizer, forest resources and conservation areas. It may also do little to address greenhouse gas emissions, potentially worsening climate change.

By way of an example, the team associated with Synthetic Genomics Inc who have recently announced the creation of a synthetic cell have specifically claimed that they

would use the same technology to develop an algal species that efficiently converts atmospheric carbon dioxide into hydrocarbon fuel, supposedly addressing both the climate crisis and peak oil concerns in one fell swoop. Yet, contrary to the impression put forth by these researchers in the press, algae, synthetic or otherwise, requires much more than just carbon dioxide to grow - It also requires water, nutrients for fertilizer and also sunlight (which therefore means one needs land or open ocean - this can't be done in a vat without also consuming vast quantities of sugar).

In order for Synthetic Genomics or their partners to scale up algal biofuel production to make a dent in the fuel supply, the process would likely exert a massive drain on both water and on fertilizers. Both fresh water and fertilizer (especially phosphate-based fertilizers) are in short supply, both are already prioritized for agricultural food production and both require a large amount of energy either to produce (in the case of fertilizers) or to pump to arid sunlight-rich regions (in the case of water). In a recent life-cycle assessment of algal biofuels published in the journal *Environmental Science and Technology* researchers concluded that algae production consumes more water and energy than other biofuel sources like corn, canola, and switch grass, and also has higher greenhouse gas emissions.ⁱⁱ "Given what we know about algae production pilot projects over the past 10 to 15 years, we've found that algae's environmental footprint is larger than other terrestrial crops," said Andres Clarens, an assistant professor in U.Virginia.'s Civil and Environmental Department and lead author on the paper.ⁱⁱⁱ Moreover scaling-up this technology in the least energy-intensive manner will likely need large open ponds sited in deserts, displacing desert ecosystems. Indeed the federally appointed Invasive Species Advisory Committee has recently warned that non-native algal species employed for such biofuel production could prove ecologically harmful and is currently preparing a fuller report on the matter.^{iv}

Meanwhile it is not clear that the yield from algal biofuels would go far to meeting our energy needs. MIT inventor Saul Griffiths has recently calculated that even if an algae strain can be made 4 times as efficient as an energy source than it is today it would still be necessary to fill one Olympic-size swimming pool of algae every second for the next twenty five years^v to offset only half a terawatt of our current energy consumption (which is expected to rise to 16 TW in that time period). That amounts to massive land use change. Emissions from land use change are recognized as one of the biggest contributors to anthropogenic climate change.

Moving Forward - Time for new regulation

The rapid adoption of synthetic biology is moving the biotechnology industry into the driving seat of industrial production across many previously disparate sectors with downstream consequences for monopoly policy. Meanwhile its application in commercial settings uses a set of new and extreme techniques whose proper oversight and limits has not yet been debated. It also enables many more diverse living organisms to be produced using genetic science at a speed and volume that will challenge and ultimately overwhelm the capacity of existing biosafety regulations. For example, Craig Venter has claimed in press and in his patent applications that when combined with robotic

techniques the technology for producing a synthetic cell can be perfected to make millions of new species per day.^{vi} Neither the US government nor any other country has the capacity to assess such an outpouring of new synthetic species in a timely or detailed manner. The Energy and Commerce Committee urgently needs to suggest provisions for regulating these new organisms and chemicals derived from them under the Toxic Substances Control Act, Climate Change legislation and other legislation under its purview before allowing their release into the environment. It also needs to identify how it intends to ensure that the use of such organisms whether in biorefineries, open ponds or marine settings does not impinge on agriculture, forestry, desert and marine protection, the preservation of conservation lands, rural jobs or livelihoods.

To conclude, Congress must receive this announcement of a significant new lifeform as a warning bell, signifying that the time has come for governments to fully regulate all synthetic biology experiments and products. It is imperative that in the pursuit of scientific experimentation and wealth creation, we do not sacrifice human health, the environment, and natural ecosystems. These technologies could have powerful and unpredictable consequences. These are life forms never seen on the planet before now. Before they are unleashed into the environment and commercial use, we need to understand the consequences, evaluate alternatives properly, and be able to prevent the problems that may arise from them.

If you have, any questions please contact: Jim Thomas at jim@etcgroup.org or 1-514-273-9994, Eric Hoffman at ehoffman@foe.org, or 202-222-0747, or Jaydee Hanson at jhanson@icta.org or 703-231-5956.

Sincerely,

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Program Manager

ETC Group (Action Group on Erosion, Technology and Concentration)
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ⁱ For an introductory overview of societal issues raised by Civil Society around Synthetic Biology see ETC Group, “Extreme Genetic Engineering: An Introduction to Synthetic Biology” (Ottawa, ON: ETC Group, 2007). Available online at <http://www.etcgroup.org/en/node/602>

ⁱⁱ Andres F. Clarens, Eleazer P. Resurreccion, Mark A. White and Lisa M. Colosi. Environmental Life Cycle Comparison of Algae to Other Bioenergy Feedstocks. *Environmental Science & Technology*, 2010; 100119091456057 DOI: 10.1021/es902838n

ⁱⁱⁱ University of Virginia (2010, January 25). Engineers find significant environmental impacts with algae-based biofuel. *ScienceDaily*. Retrieved May 26, 2010, from <http://www.sciencedaily.com/releases/2010/01/100121135856.htm>

^{iv} NISC note, “Biofuels: Cultivating Energy, not Invasive Species” Approved by the Invasive Species Advisory Committee (ISAC) on August 11, 2009 . Accessed online at www.invasivespecies.gov/home_documents/BiofuelWhitePaper.pdf

^v Saul Griffith’s presentation to the Long Now Foundation “Climate Change Recalculated” available online at <http://www.longnow.org/seminars/02009/jan/16/climate-change-recalculated/>

^{vi} For Venter’s claim see US Patent Application US20070264688A1: “Synthetic Genomes”. For discussion of the implications of this see Jim Thomas, ETC Blog “Synthia gets a Shotgun” accessed online at <http://etcblog.org/2007/12/09/synthia-gets-a-shotgun-goodbye-genetic-engineering/> 9th December 2007.