

ACCELERATING TO THE NAVY & MARINE CORPS AFTER NEXT



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Virtual Workshop on Alternative Materials
Information Technology and Innovation Foundation
Boston University Institute for Sustainable Energy
Fraunhofer USA Center for Manufacturing Innovation
Wednesday, February 17, 2021.

Re-Think Biology



<https://www.biwahaku.jp/smith/facts.html>



www.coatingsworld.com/issues/2019-07-01

Biology is engineered to survive unforgiving environments.

Engineered biology exploits biochemistry to weather the continuous pressure of tremendous physical forces.

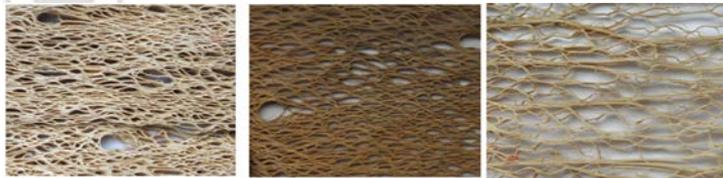


Courtesy of ONRG performers K-Y Lee and T Ellis, Imperial College London

Biology works within the confines of a net zero carbon equation.

MOTOR	RPM	EFFICIENCY
	~6000	~20-40%
	19,200	~30% (Mercedes up to 50%)
	~3500	~20%
	102,000	~100%

Courtesy of ONRG performer T Pilizota, University of Edinburgh



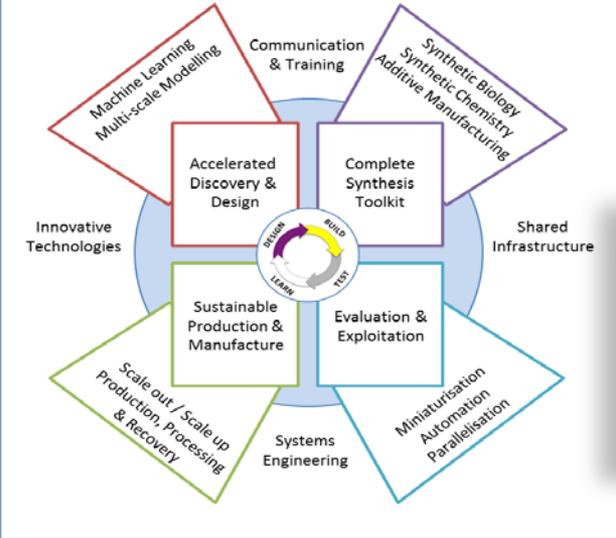
Courtesy of ONRG performers F Scarpa and A Perriman, University of Bristol

Biological engineering maximizes functionality to possess larger energy dissipation properties and unusual deformation mechanisms.



The Bioengineering Discipline

Living Foundry for Synthetic Biological Materials

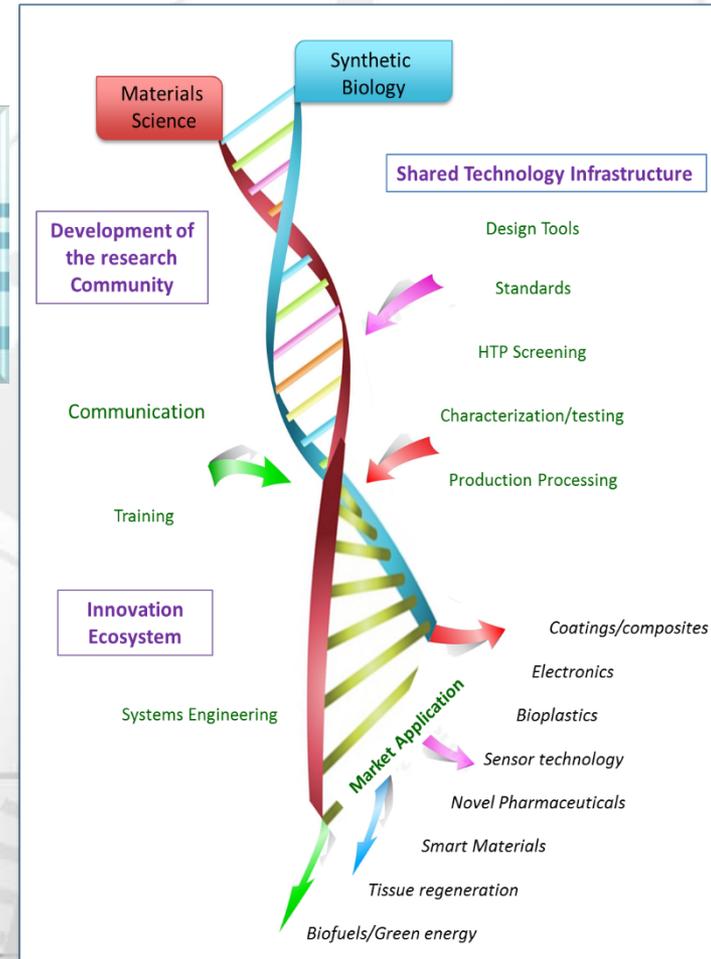


Courtesy of ONRG performer N Scrutton, Manchester Institute of Biotechnology

Engineering Biology platforms deliver tools that enable fully controlled material production using biology.



Contemporary material fabrication technologies are augmented with the tools of biology for predictive design and rapid evaluation; parallelized assembly of new materials through automation; high throughput characterization; and post production processing.



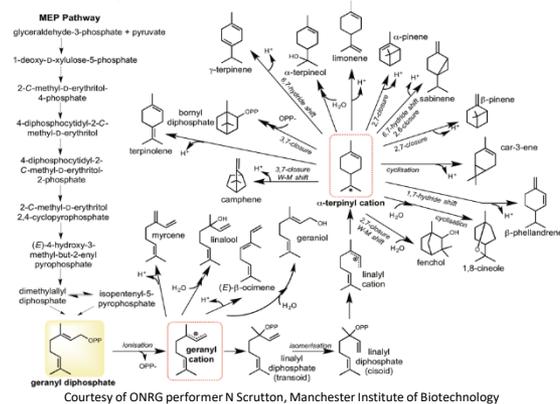
Courtesy of ONRG performer N Scrutton, Manchester Institute of Biotechnology

Manufacturing Paradigm Shift

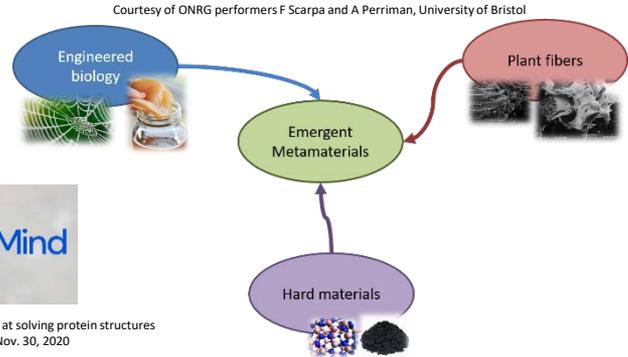
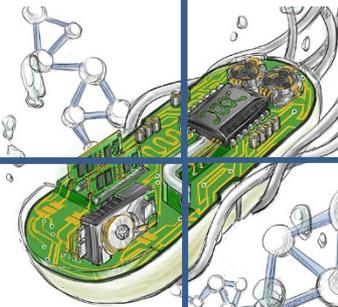
Raw Materials: waste streams can be used as revenue generating feedstock.



Power & Energy: production is not labor intensive, requires less energy, and is a near zero sum equation.

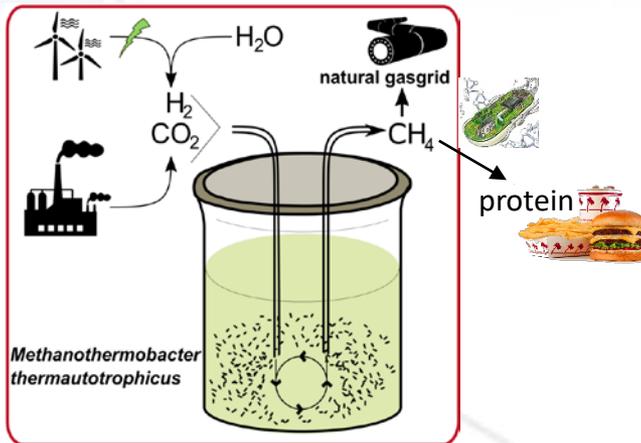
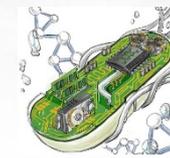


Manufacturing: industry no longer requires the contemporary footprint for industrial scale production quantities.



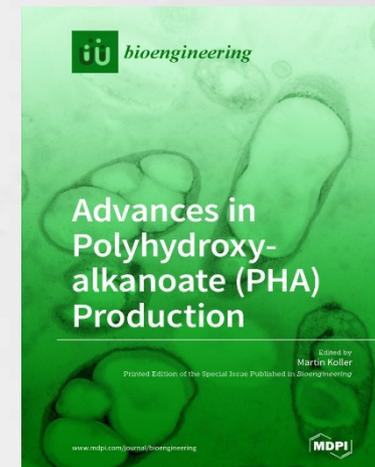
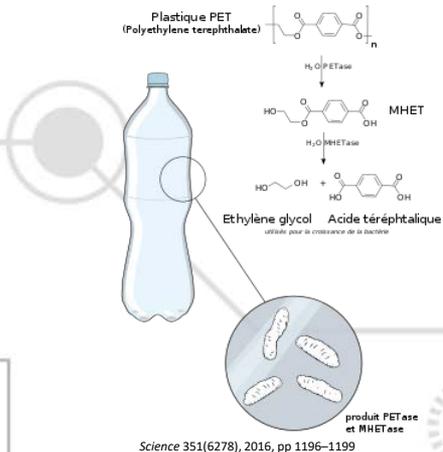
'The game has changed.' AI triumphs at solving protein structures
By Robert F. Service Nov. 30, 2020

Maker Space: physical space to produce existing and novel materials larger than can be currently intelligently conceived.



Nature has evolved a wealth of enzymes to mediate the selective construction and deconstruction of polymers with diverse structures and functions.

Biological engineering of enzymes and catabolic pathways can be exploited to deconstruct anthropogenic polymers and materials.

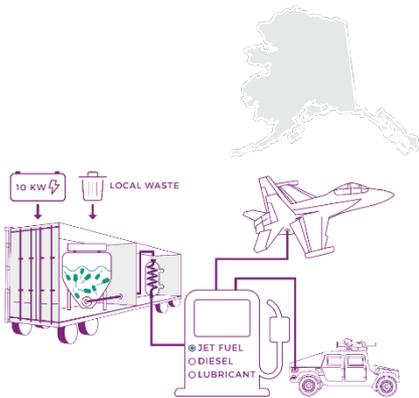




Bioindustrial Manufacturing

Instigator for the 4th Industrial Revolution

The global R&D community outside the US accounts for approximately 75% of the investment, 80% of the researchers, and over 80% of the technical publications.



Courtesy of ONRG performer N Scrutton, Manchester Institute of Technology



Courtesy of ONRG performer T Scheibel, University of Bayreuth



Courtesy of Benjamin Harvey, NAWCWD China Lake

Bioindustrial manufacturing is already integrating into petrochemical, synthetic chemistry industries etc., to help produce precursor materials and final products.

There is enough feedstock in the US to power bioindustrial manufacturing for decades.

- *Heme to make an Impossible Burger.*
- *Sitgaliptin, increases insulin secretion by inhibiting dipeptidyl peptidase 4.*
- *hyaline family of films are clear, flexible, and mechanically robust making them suitable for flexible electronics.*
- *ProveN fertilizer being applied to corn.*
- *Kymriah, produced by genetically modifying a patient's T cells.*
- *Calyno high-oleic oil from soy.*

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Thank You!

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<http://www.onr.navy.mil/Science-Technology/ONR-Global.aspx>