Biomimicry Energy Systems: What's Next?

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Biomimicry (also known as biomimetics) is the process of using natural-world mechanisms, many of which have evolved over billions of years, to inspire man-made designs and technological innovations. The following examples highlight pioneering energy ideas and active areas of research, all inspired by nature:

Energy Efficiency

- Termite mounds inspired regulated airflow for temperature control of large structures, preventing wasteful air conditioning and saving 10% energy.[1](http://http://bioinspiration.sandiegozoo.org/content/bioinspiration-story)
- Whale fins shapes informed the design of new-age wind turbine blades, with bumps/tubercles reducing drag by 30% and boosting power by 20%.[2](http://www.pratt.duke.edu/news/mimic
king-humpback-whale-flippers-may-improve-airplane-wing-design)[3](http://bioinspiration.sandiegozoo.org/content/bioinspiration-story)[4](http://www.whalepower.com/drupal/?q=node/1)
- Stingray motion has motivated studies on this type of low-effort flapping glide, which takes advantage of the leading edge vortex, for new-age underwater robots and submarines.[5](http://www.popsci.com/article/technology/why-underwater-robots-should-swim-stingrays?dom=P
SC&loc=recent&Ink=5&con=why-underwater-robots-should-swim-like-stingrays)[6](http://ww
w.mnn.com/earth-matters/animals/stories/what-submarines-can-learn-from-stingrays)
- Studies of microstructures found on shark skin that decrease drag and prevent accumulation of algae, barnacles, and mussels attached to their body have led to “anti-biofouling”
technologies meant to address the 15% of marine vessel fuel use due to drag.[7]
(http://money.cnn.com/2013/05/31/technology/innovation/sharklet/)[8]
(http://www.nasa.gov/centers/langley/news/factsheets/Riblets.html)[9]
(http://bioinspiration.sandiegozoo.org/content/bioinspiration-story)

Energy Generation

- Passive heliotropism exhibited by sunflowers has inspired research on a liquid crystalline
elastomer and carbon nanotube system that improves the efficiency of solar panels by 10%,
without using GPS and active repositioning panels to track the sun.[11](http://www.theengineer.co.uk/sectors/energy-and-environment/news/sunflower-heliotropism-could-inspire-design-of-solar-panels/1013611.article)[12]
(http://www.ted.com/talks/bill_gross_on_new_energy.html)[13]
(http://www.news.wisc.edu/20967)
- Mimicking the fluid dynamics principles utilized by schools of fish could help to optimize the
arrangement of individual wind turbines in wind farms.[14](http://www.macfound.org/fellows/30/)
- The nanoscale anti-reflection structures found on certain butterfly wings has led to a model to
effectively harness solar energy.[15](http://www.nytimes.com/2012/04/03/science/solar-energy-inspiration-from-butterflies.html?_r=0)[16]
(http://pubs.rsc.org/en/Content/ArticleLanding/2011/CP/c1cp20787c#!divAbstract)

Energy Storage

- Inspired by the sunlight-to-energy conversion in plants, researchers are utilizing a protein in
spinach to create a sort of photovoltaic cell that generates hydrogen from water (i.e. hydrogen
- Utilizing a property of genetically-engineered viruses, specifically their ability to recognize and
bind to certain materials (carbon nanotubes in this case), researchers have developed virus-based “scaffolds” that could enable assembly of high-power lithium-ion batteries.[20](http://www.greencarcongress.com/2009/04/mit-team-uses-genetically-engineered-viruses-to-build-cathode-material-for-liion-battery.html)[21]
(http://www.sciencemag.org/content/324/5930/1051)

Energy Delivery

- Mimicking the sharp, jagged scales found on fireflies by implementing radiance-amplifying
geometry has been shown to increase LED brightness by 55%.[22](http://www.popsci.com/science/article/2013-01/researchers-reverse-engineer-fireflies-make-more-efficient-leds)[23]
(http://vmconnection.com/biomimicry-design-lessons-from-nature/)
- The distributed social structure of ants and bees, specifically for communication and activity
scheduling, is influencing the complex and adaptive control systems required for smart
(http://www.greenbiz.com/blog/2013/11/05/5-tech-trends-mingling-bio-inspired-design)
- Neural networks found in the human brain are inspiring intelligent control systems for future

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