The Next Frontier of Business

Ask a grade-schooler to draw a picture of the environment, and you'll often see billowing smokestacks and factory drainpipes spewing pollution. Inherently, we see business as the villain, and it is true that the forces driving corporate America have created many of the environmental crises we face today. As our global prosperity has grown, markets have been chewing up the planet because they fail to account for the true costs of pollution.

But what if we could turn that equation on its head and enlist business in a global movement to save our fragile ecosystem? What if we could leverage the profit motive and the human urge for innovation to solve our environmental problems? After all, profit, at its root, comes from smartly anticipating and meeting human wants and needs, which include clean air, clean water and a safe place to live. And innovation is as deeply engrained in the American psyche as the Wright Brothers' "flying machine" and President Kennedy's mission to the moon. Joined and harnessed, these two historic drivers of human enterprise—profit and innovation—can save our planet from catastrophe and pioneering businesses can lead the way.

Gwen Ruta
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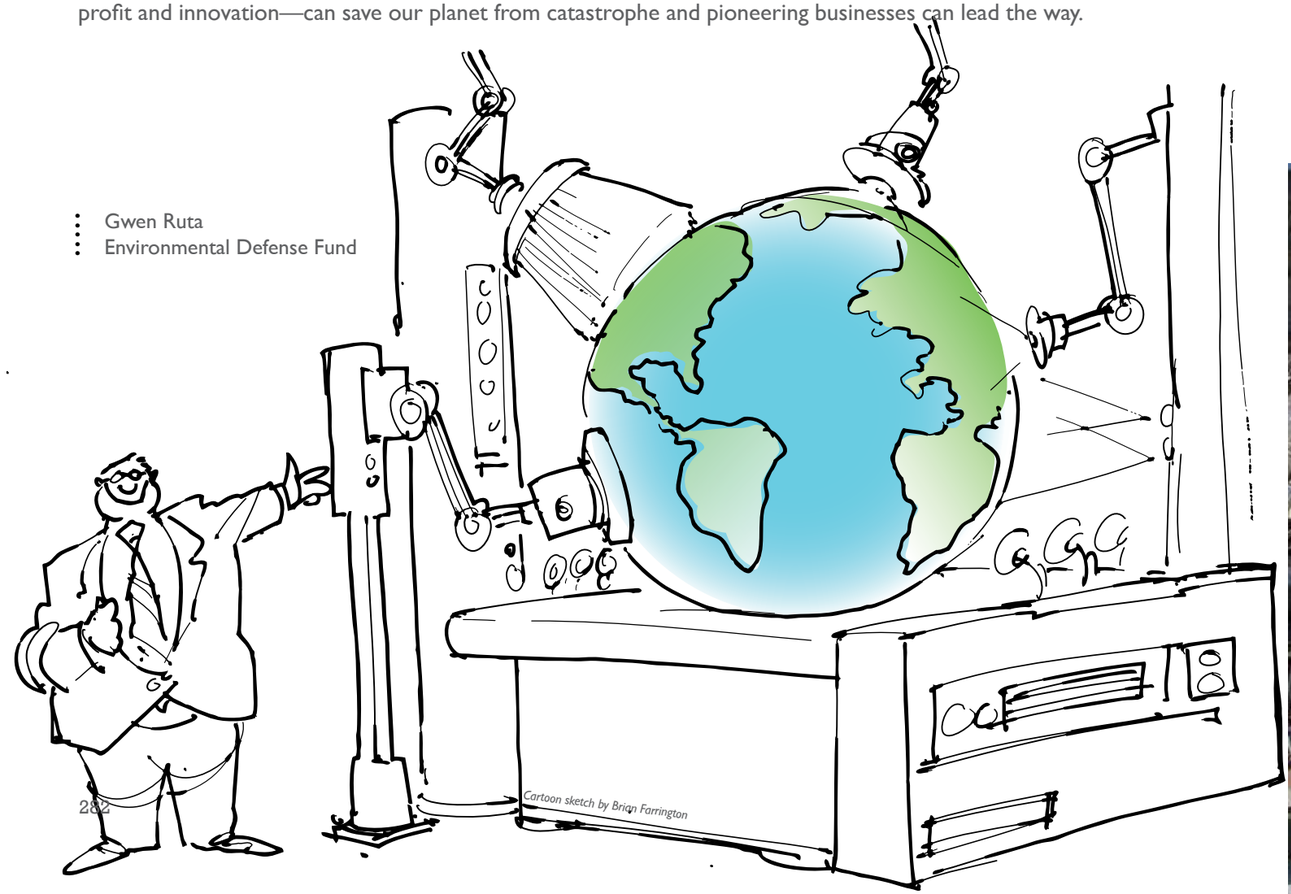

Cartoon sketch by Brian Farrington

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The Promise of Innovation

Innovation is taking place all over this country every day, from small process improvements on the factory floor to emerging new products that will change the way we work and live. Let's take a look at some examples that illustrate how much there is to build on:

Materials Building materials that adjust to weather conditions, super-strong but lightweight auto bodies that boost fuel efficiency, clothing that resists stains and repels water—all this and more is in the works. New kinds of materials are being developed every day that can sense and adjust to the world around them and change their properties (like flexibility or electrical conductivity) in an instant. Lightweight, self-healing plastics would make vehicles and aircraft more fuel-efficient and safer.[1] Moreover, it's possible that the next materials revolution will come not from creating new chemicals, but from mining our landfills and using discarded materials. North American landfills contain more aluminum than we can produce by mining, and the same may be true of gold and copper, which are used in the circuit boards of electronics. One ton of trashed computers contains more gold than 17 tons of ore, and there's no shortage of them; Americans toss out 50 million computers annually. Enterprising companies are developing landfill mining technologies such as rotating magnets that pull lightweight metals from the trash heap.[2]

Energy We're all familiar with wind power and solar energy, but how about ocean energy, which turns wave action into electricity, or geothermal power, which uses the earth's heat to do the same? And what if instead of gasoline from petroleum, we were able to create fuel from yeast, or algae? Algae has the potential to produce ten times the fuel per acre than corn (for ethanol) or soybeans (for biodisesel), and it can be grown in arid land or brackish water—areas that wouldn't compete

Swiss Federal Laboratories for Materials Testing and Research

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Photo courtesy Randy Montoya and Sandia National Laboratories

Replacing half of the world's oil with algae-derived fuel could reduce CO2 emissions by 25 percent.

A researcher adjusts the nutrient injection ports on an algal tank mixing arm. As part of a project to create alternative sources of energy, researchers at Sandia National Laboratories are cultivating green algae that holds promise as a new supply of biofuel.

with food production. Moreover, algae could have a positive influence on reversing climate change because it consumes CO2. Replacing half of the world's oil with algae-derived fuel could reduce CO2 emissions by 25 percent.[3] These advances in energy technology are all in the works today, along with the crucial components that will make them work, like high-efficiency batteries that can store power generated when the wind blows to meet our energy needs in calm weather, or lightweight materials that hold tiny solar cells and act as an energy-generating "skin" around a building. The 2009 Solar Decathalon, a biannual collegiate competition, featured a home that was covered with 250 thin-film solar panels and topped with 11 rooftop panels, producing 200 percent of the energy needed to run the home.[4]

A new office complex in Zimbabwe stays cool without air conditioning and uses 90% less energy for ventilation than conventional buildings of its size.

Smart Design Designers of consumer and commercial products are starting to factor environmental impacts into the design process, looking at not just the direct impacts (energy or resource inputs and waste outputs), but also at the full lifecycle from extraction of raw materials to processing intermediaries to manufacturing all the way to use and disposal of the product. One design concept that is catching on is cradle-to-cradle design based on the ecological concept that "waste is food." Building on that concept, cradle-to-cradle products are designed to be reused or recycled.

Biomimicry What can termites teach us about architecture? A lot, as it turns out. Researchers have imitated termites' ability to maintain steady temperatures inside their mounds at a new office complex in Zimbabwe. It stays cool without air conditioning and uses 90 percent less energy for ventilation than conventional buildings of its size.[5] This is just one example of biomimicry, a new science that is taking the best ideas of Mother Nature and applying them to help solve society's toughest problems in a sustainable way. After 3.8 billion years of trial and error, animals, plants and microbes have figured out what works. For example, photosynthesis—the process by which plants use chlorophyll to convert sunlight, water and CO2 into carbohydrates and oxygen—is inspiration for a possible clean fuel solution. Scientists are working to reproduce this process to split water into hydrogen and oxygen, using

People take a first look inside the house of Technische Universität Darmstadt, Germany, on the opening day of the US Department of Energy Solar Decathlon 2009 in Washington, DC. Team Germany's house which integrated thin-film copper indium gallium selenide (CIGS) cells generates 200 percent of the house's energy needs and won overall first place.

Photo courtesy Jim Tetro, US Department of Energy Solar Decathlon

Photo courtesy Mattes, Wikimedia Commons

BMW showcased its Hydrogen 7 CleanEnergy car, the world's first production-ready hydrogen vehicle.

up excess CO2 along the way. If commercialized, the process would make hydrogen fuel cells an efficient and inexpensive way to create and store energy.[6]

Hybrid Vehicles Hybrid technology continues to evolve, with new models available for delivery trucks and utility vans, and new ways of storing and managing energy being developed. Foremost among these are so-called hydraulic hybrids, which store energy in the form of pressurized fluid, and plug-in hybrids, where the battery can be charged through an electrical outlet. Because they operate primarily on electricity for the first 20 to 40 miles, plug-in hybrids can achieve 70 to 100 miles per gallon, quadrupling the fuel economy of the average car on the road today.

The federal government calculates that 84 percent of US cars, pickup trucks and SUVs could switch to plug-in hybrid technology without any changes needed to our existing electrical grid. If this happened, we would reduce national gasoline consumption by 6.5 million barrels each day, which is equivalent to over half of US petroleum imports.[7]

A Global Change Engine

Couple innovation with profit—in other words, business innovation—and what have you got? An engine for global change.

That engine is just getting started in the environmental arena, but it has the power to turn our planet's biggest environmental problems into its biggest economic opportunities. As we move from the agricultural revolution of the 18th century to the Industrial Revolution of the 19th century, to the information revolution of the 20th century, can we create a new innovation revolution in the 21st century?

While these innovations are nearly ripe, it will take the right combination of progressive market forces and smart policies to get them from the drawing room table to the factory floor quickly enough to change our planet's environmental trajectory.

Triple Bottom Line: The "3 Ps"

- This new way of thinking recognizes that over the long run, a business is not sustainable without healthy, happy employees along with a healthy, productive planet.

vs.

Traditional Bottom Line

- Financial returns are the sole determinant of success.

The innovations discussed earlier are nearly ripe, but it will take the right combination of market forces and smart policies to get them from the drawing table to the factory floor quickly enough to change our planet's environmental trajectory. For example, governments around the world are adopting targets for lowering greenhouse gas emissions and creating carbon markets to help reach those targets. These systems provide a level playing field for entrepreneurs and financiers, opening a tap of investment dollars that will flow to clean vehicles, renewable energy and other green technologies. Some have estimated that the market for trading greenhouse gas emissions could grow to be as large as the stock market in the United States. That would mean tens of billions of dollars invested in new ways to cut energy use and greenhouse gas emissions.

From Orville and Wilbur Wright to Steve Jobs and Bill Gates, America has always been home to great innovators. Today, we look to the next generation to bring business to the forefront of the environmental movement and to launch the inventions that can have profound benefits. There will be a period of trial and error—not every new technology will succeed or be accepted. But some will catch on, and investors and executives will begin to build new businesses and new markets around them.

Competitors will jump on board, and the innovations will spread until eventually they become business as usual[8] and we move on to the next forward revolution. But in the meantime, we just might fundamentally change the relationship between business and our environment, and in the process, change our very future on this earth.

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Gwen Ruta, vice president of corporate partnerships, spearheads Environmental Defense Fund's (www.edf.org) work with multinational companies to create innovative solutions to environmental challenges. Ranked number one for effective environmental partnerships by the Financial Times, *Ruta's team has kicked off transformations in market sectors from shipping to retail to fleets. Partner companies include Walmart, KKR, FedEx, DuPont and McDonalds. Previously, Ruta held senior positions at Metcalf & Eddy, the US Environmental Protection Agency and Harvard's Kennedy School of Government. She is on advisory boards for Henderson Global Investors, the Environmental League of Massachusetts and the University of Michigan. She holds a M.P.A. from Harvard University and a B.S. from the University of Virginia.*

World-Changing Innovations

Examples of individuals, organizations and businesses that are manifesting progressive ideas are highlighted throughout this book. Here are a few more cutting-edge innovations that have potential to solve some of our greatest challenges.

Photo courtesy Bloom Energy

A Mini Power Plant in Box

While developing a technology to produce oxygen for a NASA mission to Mars, former NASA scientist, K.R. Sridhar realized that by reversing the process, he could create an energy source that is cleaner and more efficient than oil, gas or coal and more reliable than wind or solar power. "This technology is fundamentally going to change the world," said Sridhar, cofounder and CEO of Bloom Energy. "It's going to have a disruptive impact on the way energy is produced."[1] Called a Bloom Box, the technology is essentially a fuel cell that generates electricity on site without burning or combustion. The fuel cells work by oxidizing the fuel, which is up to two times more efficient than combustion. In their efforts to reduce their CO2 footprints, Google, Walmart, eBay and other large corporations have installed industrial-sized models. Bloom Energy plans to tap into the residential market with a unit that will power a single-family home using half the fuel and halving carbon footprint of grid-supplied electricity.[2]

Photo courtesy Tomorrow Never Knows, flickr

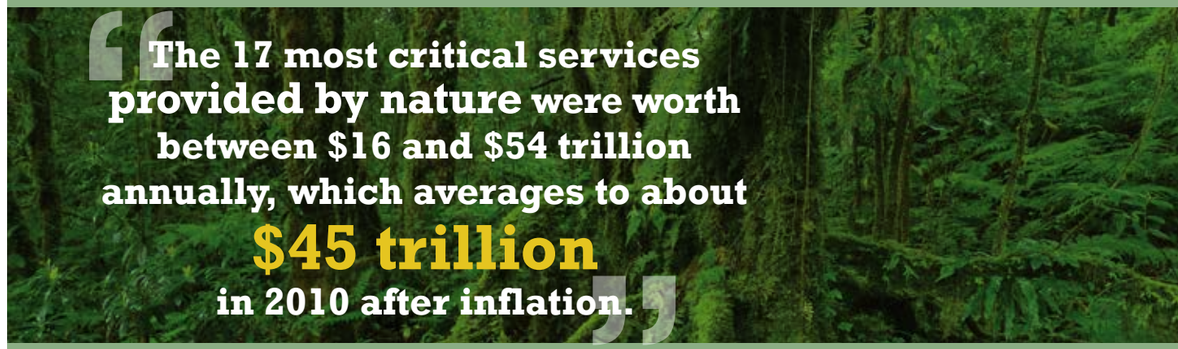
Oil-Eating Mushrooms

Mycologist and inventor Paul Stamets believes that mushrooms can save the world. One way is through mycoremediation—the clean up of environmental pollution with fungi. "There are dozens of examples of how mushrooms can be used for bioremediation," said Stamets. "Mycelium [the branching, vegetative part of a fungus] of oyster mushrooms can eat petroleum products, denaturing them, and the mycelium converts the hydrocarbons into cellular carbohydrates.[3] One of Stamets' projects introduced oil-eating fungi to a diesel oil-contaminated site. His research showed a 95 percent breakdown of hydrocarbons after eight weeks. As the mushrooms rotted away, gnats moved in to eat the spores. The gnats attracted other insects, which attracted birds, which brought in seeds. Soon the site was teaming with life and well on the way to being ecologically restored. After the Deepwater Horizon spill in April 2010, Stamets submitted a proposal involving oyster mushrooms for the Gulf of Mexico clean up effort.[4]

> "This technology is fundamentally going to **change the world.**"

Magnetic Levitation (Maglev) Wind Power

Combining vertical blades and magnets, a single maglev wind turbine can produce enough energy to power 750,000 homes. The maglev does not need any electricity to operate, there is no energy loss through friction and each unit has a projected life span of 500 years.[5] Conventional utility-scale wind turbines require wind speeds of 13 miles per hour in order to produce energy[6] while the maglev will operate speeds as slow as 5 feet per second. Building a single giant maglev wind turbine would reduce construction and maintenance costs and require much less land than hundreds of conventional turbines.[7] "Unlike any other form of renewable energy, wind energy has the greatest potential for energy independence," said Ed Mazur inventor of a commercial-sized maglev wind turbine.[8]



Seeing the Full Value of Ecosystems

In policy, economics and business, decisions are always made with cost-benefit in mind. For years, natural ecosystems were not integrated in this quantitative decision-making process. The environment was not a part of the bottom-line.

But intuitively we all know that ecosystems have value. For example, the shade of a tree eliminates the need to bring an umbrella everywhere. On a larger scale, healthy forests sequester carbon emissions, filter water, and produce oxygen.

Valuing all these services in dollars and cents is a momentous task. In 1997 a group of 13 economists and environmental scientists made the first and only highly-reputed attempt, estimating that the 17 most critical services provided by nature were worth between $16 and $54 trillion annually, which averages to about $45 trillion in 2010 after inflation.[1]

In the years following that landmark study, ecosystems valuations has become far more practical and precise. Faced with the prospect of building an $8 billion water filtration facility to deal with dropping water quality, New York City instead chose to purchase and protect land throughout the Catskills Mountains for $1.5 billion. New Yorkers' water bills might have doubled to pay for the plant—instead they increased just 9 percent.[2] Many traditional economists question the accuracy of dollar values attached to ecosystems, but sometimes the evidence is inarguable. After Hurricane Katrina devastated the Gulf Coast, scientists pointed out that the now fast-disappearing coastal wetlands once buffered the region against storms. Further study prompted by Katrina found that coastal wetlands provide over $23 billion in storm protection services every year.[3] Informed by ecosystems valuations like these, the state of Louisiana decided to reinvest every penny of roughly $200 million of new offshore oil tax revenues into rebuilding its wetlands.[4]