Eco-Synergy™
Innovative Design in Harmony with Nature

The Ohio State University (OSU) has developed an approach called Eco-Synergy™ that creates mutually beneficial linkages between industrial supply chains and critical natural resources. It enables the design of sustainable products and processes by accounting for ecosystem services.

Why are ecosystem services important?

Ecosystem services are essential to the functioning of human society. Not only do ecosystems provide essential water, foods, fibers, fuels, and raw materials; they also provide less obvious, but equally important services such as climate regulation, nutrient cycling, pollination, and carbon sequestration. Unfortunately, ignorance about the life-supporting role of ecosystems has led to unsustainable practices. Studies show that most **ecosystem services are degraded** in the U.S. and around the world. Yet, paradoxically, few are aware of this threat to the continued health of the global economy.

Recently there has been a growing understanding of ecosystem services within the business and finance community. Valuation of companies is no longer based purely on their booked assets, i.e., economic capital, but also considers access to essential resources—natural capital, as well as human and social capital. Researchers at OSU and elsewhere are seeking to respond to this newfound interest by creating a new generation of tools to analyze the value of ecosystem services.

What is Eco-Synergy™?

Eco-Synergy™ is a design philosophy, combined with a set of analytic tools, which helps companies to systematically identify beneficial synergies between their operations and the surrounding ecological resources. The approach is based on a mutual value proposition: **Industrial systems can be designed to work in harmony with natural ecosystems, so that both can flourish**. Through a better understanding of the relationship between supply chain operations and the supporting natural resources, business managers can reduce operating costs, avoid adverse environmental impacts, raise capital productivity, and thus increase shareholder value while enriching the environment.

The Eco-Synergy™ approach begins by analyzing the demand and supply of ecosystem services within a selected boundary, e.g., a local site, town, or region. Demand is estimated from resource use and emissions, while supply is estimated from ecosystem characteristics. This provides insight into potential mismatches between the demand for specific services and the capacity of ecosystems within the boundary. Moreover, it enables the design of cost-effective hybrid networks that link technological and ecological systems in order to satisfy demand within the local ecosystem capacity. Frequently, the demand can only be fulfilled by importing resources from outside the boundary, and life cycle assessment methods are utilized to estimate the implied **ecosystem service footprint**.

To learn more, visit the **Center for Resilience** *website* (www.resilience.osu.edu) *or contact either:*

Bhavik Bakshi, 614-292-4904, bakshi.2@osu.edu **Joseph Fiksel**, 614-688-8155, fiksel.2@osu.edu

What are some examples of ecological synergies?

Examples include the use of wetlands for wastewater treatment, forests for reducing pollution and sequestering CO_2, and land management to enhance pollination and agricultural yield. **Companies that harness nature's services** can reduce demand for energy, water, and other resources, thus decreasing their supply chain footprint while improving profitability, resilience, and competitiveness. For example, the crop protection company Syngenta integrates ecosystem service considerations into developing new products that are less water-intensive, more resistant to pests, and more tolerant of dry or salty soils. Dow Chemical is partnering with The Nature Conservancy to develop a better understanding of how their land use decisions and capital investments can be designed to protect ecosystem services. The Ohio By-Product Synergy Network, launched by OSU, repurposes about 30,000 tons of solid waste annually, thus saving about $4 million while avoiding about 700,000 tons of greenhouse gas emissions.

What are the unique capabilities of the Eco-Synergy™ approach?

In order to support the Eco-Synergy™ approach, OSU has developed advanced tools that enable a **systems view** of industrial supply chains and their supporting ecological resources. These include:

- **Eco-LCA™** a web-based tool that quantifies how industrial activities use or effect ecosystem services in terms of mass, energy, or money, and can consider systems at multiple scales.
- **Eco-Flow™** is an optimization tool that enables design of material and energy flow networks to maximize both enterprise profitability and ecosystem service protection.

These tools are being integrated with models of ecosystem services such as InVEST for valuing the impact of land use and land cover changes on ecosystem services, and CENTURY for quantifying the impact of agricultural practices on carbon and nitrogen cycles. Current projects using Eco-Synergy™ include design of residential systems and design of bio-based material supply chains.

In summary, Eco-Synergy™ **expands the design space** by supporting breakthrough innovations that would not be discovered by traditional engineering methods. It enables both a **bottom-up** approach that develops "islands of sustainability" within local carrying capacity, and a **top-down** approach that leverages ecosystem services at a regional or national scale.

How Eco-Synergy™ compares to existing sustainable design approaches

	Scope	Design Objectives	Accounts for Eco-Services	Considers Eco-Capacity
Life Cycle Assessment	Life cycle	Minimize resource impact per functional unit	Some	No
Ecological Footprint	Life cycle	Reduce overshoot of aggregated biocapacity	Some, Aggregated	Aggregated
Cradle to Cradle	Not life cycle	Close loops, use solar energy, seek diversity	No	No
Byproduct Synergy	Industrial network	Maximize profit, close resource loops	No	No
Eco-Synergy™	Multi-scale & life cycle	Close loops, maximize profits, and reduce overshoot of specific ecosystem services	Yes	Yes