Sandia National Laboratories

FROM CONCEPT TO COMMERCIALIZATION:
LEVERAGING TEA AND LCA AT SANDIA NATIONAL LABORATORIES

At Sandia, techno-economic analysis (TEA) is designed to maximize the impact of technological innovations by applying a comprehensive, systems-thinking approach throughout the technology life cycle. Life cycle assessment (LCA) systematically evaluates the environmental impacts associated with all stages of a product's life, from raw material extraction through production, use, and disposal. Together, TEA and LCA provide a holistic view of both environmental sustainability and economic feasibility, empowering stakeholders to make informed decisions.

CONCEIVE

Filter technology concepts to eliminate those with fundamental barriers and promote those with significant benefits, ensuring that resources are focused on the most promising technologies, increasing the likelihood of successful outcomes.

Example: Wind Turbine Blade Recycling

- **Application:** TEA helps identify the most efficient and cost-effective methods for recycling wind turbine blades, considering both technical feasibility and economic viability. LCA complements this by assessing the environmental impacts of various recycling methods, ensuring that the chosen approach minimizes waste and resource consumption.
- **Impact:** By promoting sustainable recycling practices, TEA and LCA together support the development of a circular economy in the wind energy sector, reducing waste and environmental impact.

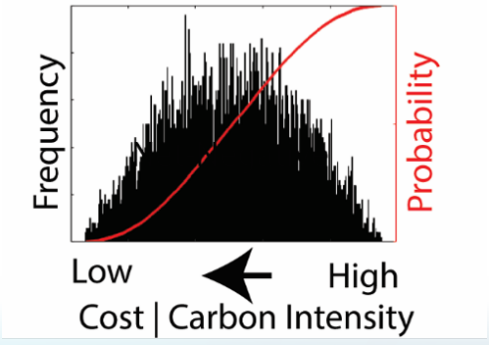


DEVELOP

Guide research and development efforts and define credible cost and performance targets to provide clear direction for R&D activities, aligning them with economic and technical feasibility.

Example: Cement & Concrete Emissions Mitigation with Emerging and New Technologies (C2EMENT) Consortium

- **Application:** Sandia leads Group 3 in the C2EMENT consortium, which focuses on low-carbon fuels, feedstocks and energy sources (LCFFES). Sandia's contributions involve assessing the economic and environmental sustainability of LCFFES scenarios. This includes analyzing factors such as cost, life cycle costs, scalability and carbon intensity.
- **Impact:** This program aims to accelerate industrial demonstration efforts by addressing critical risks associated with adopting emerging technologies. Pacific Northwest National Laboratory will collaborate with a multi-institutional team comprising experts from government, industry, and academia, including Sandia. Overseen by the Office of Technology Transitions and the Office of Clean Energy Demonstrations, C2EMENT is supported by the Industrial Efficiency & Decarbonization Office and the Office of Manufacturing and Energy Supply Chains.



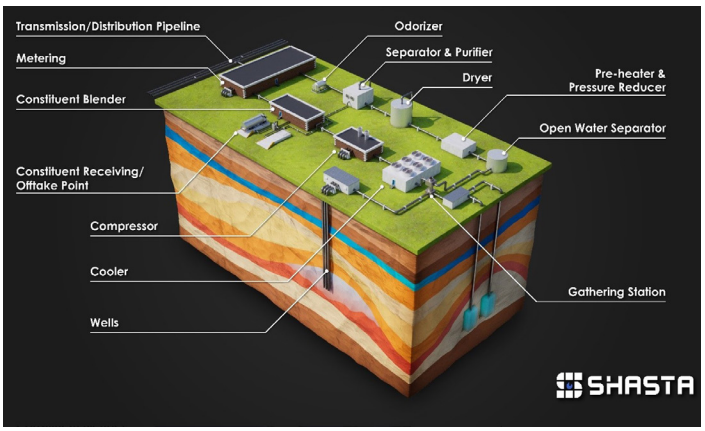
Probability Distribution of Costs and Carbon Intensity in Industrial Processes under Variability in Fuels, Feedstocks, and Thermal Energy.

REALIZE

Identify entry markets as well as envision markets and use cases that may not yet exist to facilitate the strategic positioning of technologies, enhancing their market potential and adoption.

Example: Subsurface Hydrogen Storage and Transport Assessment (SHASTA)

- **Application:** TEA helps assess the economic viability of subsurface hydrogen storage technologies, evaluating costs associated with site selection, infrastructure development, and operational expenses. LCA complements this by analyzing the environmental impacts of hydrogen storage, including potential emissions and resource use throughout the life cycle of the storage process.
- **Impact:** By integrating TEA and LCA, the SHASTA project identifies the most promising hydrogen storage solutions that are both economically feasible and environmentally sustainable, promoting the development of a clean hydrogen economy.



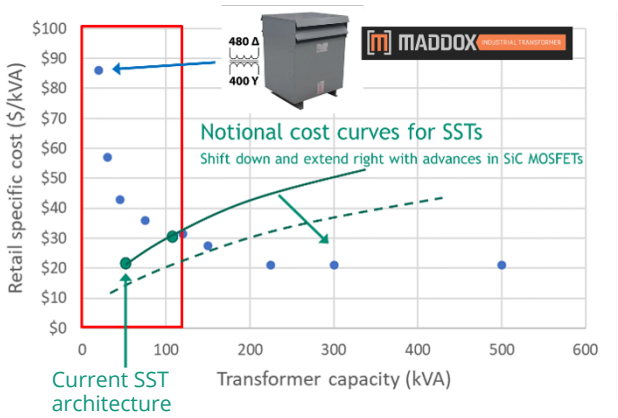
Underground storage of H_2 is less costly than storage in aboveground vessels but significant technical challenges must be addressed to store H_2 economically and safely at the commercial scale. SHASTA research focuses on quantifying materials compatibility, investigating core- and reservoir-scale performance and characterizing microbial interactions, and understanding the cost drivers and cost-effective locations for H_2 storage.

ACHIEVE

Support the transition of technologies from Sandia to the private sector and ensure that innovations developed at Sandia have a clear pathway to commercialization, maximizing their real-world impact.

Example: Solid-State Transformers for the Electrical Grid

- **Application:** TEA supports the transition of solid-state transformer technologies (SST) to the private sector by demonstrating their economic viability and market potential. LCA evaluates the environmental benefits of these technologies, such as reductions in greenhouse gas emissions.
- **Impact:** The application of TEA and LCA identifies promising entry markets, supports the development of the SST value proposition, and highlights a path to access higher volume markets as the technology matures.



EXCEPTIONAL SERVICE IN THE NATIONAL INTEREST

Sandia National Laboratories is committed to delivering exceptional service in the national interest. By leveraging TEA and LCA, Sandia ensures that its technological innovations are not only scientifically and technically sound but also economically viable and environmentally sustainable.

U.S. Department of ENERGY | NNSA National Nuclear Security Administration

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