Argonne NATIONAL LABORATORY

HELPING ENERGY INDUSTRY STAKEHOLDERS **PRIORITIZE INFRASTRUCTURE INVESTMENTS**

Argonne's Techno-Economic Analysis (TEA) Capability

THE CHALLENGE

Conducting a Techno-Economic Analysis (TEA) can be important in assessing the economic performance and thus the potential market acceptance for new technologies.

TEAs identify major cost drivers and defines possible pathways to attain price thresholds at which a new technology can match and thus becomes competitive with a current technology—which can make switching to the new technology feasible and thus more attractive to consumers and industrial users because of other perceived benefits, such as reliability, accessibility, sustainability (i.e., reuse or recycling potential that establishes a "circular economy"), and/or environmental benefits (e.g., lower emissions).

ARGONNE'S APPROACH

Researchers in Argonne's Energy Systems Division have been performing TEAs with support from the U.S. Department of Energy (DOE) since the mid-2000s when DOE started addressing the barriers to adoption of hydrogen—and specifically hydrogen energy infrastructure—as an alternative to petroleum-based fuels. The barriers are mainly the infrastructure's lack of availability and cost (see sidebar).

Argonne has expanded its suite of TEA models to evaluate the cost of fuel production and delivery processes such as electro-fuels (e-fuels), synthetic chemicals, upcycling of waste products to lubricants and fuels, and the fast charging of battery electric vehicles.

ARGONNE'S TAKE

"Barriers to market acceptance of alternative low-carbon fuels typically stem from the high costs of fuel production and/or delivery infrastructure. Techno-Economic Analysis (TEA) identifies major cost drivers in the fuel supply chain, which informs R&D and product development planning with the goal of reducing cost to be competitive with conventional fuel supply for a particular end use. Both the cost of the fuel and its environmental implication (such as its carbon intensity based on life cycle analysis or LCA) are important metrics to identify future fuel and vehicle technology options that meet both cost and environmental targets, thus guiding their market deployment plans."

–Amgad Elgowainy
Senior Scientist/Electrification and Infrastructure Group Leader
Energy Systems Division

U.S. DEPARTMENT OF ENERGY
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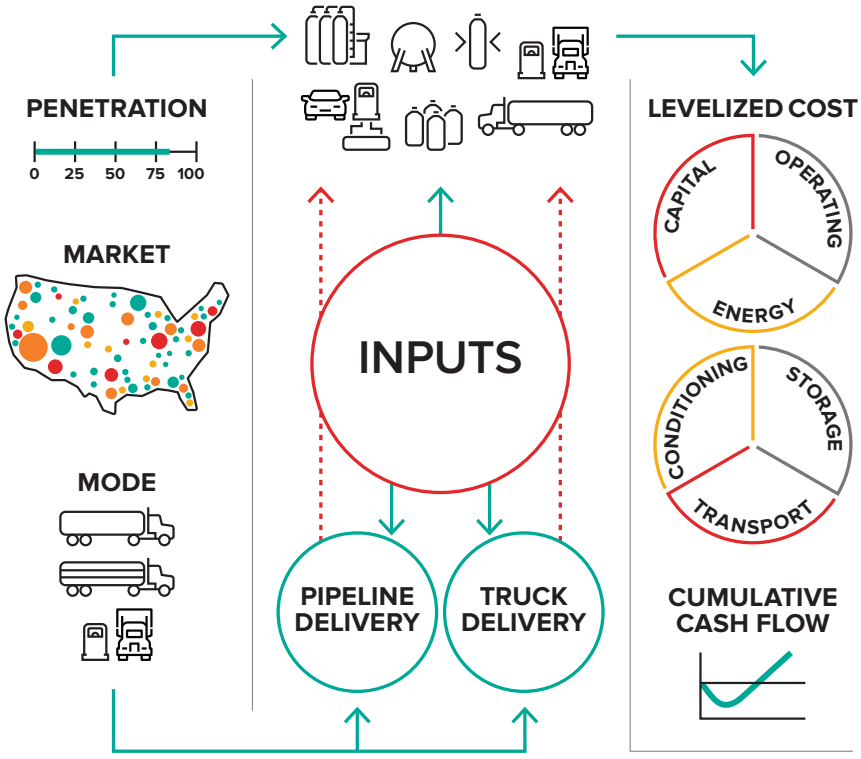
Argonne's TEA models are "bottom-up" tools. They provide an engineering-level view of process design options, sizing (or scale), and pricing of myriad components, as well as material and energy inputs at the process level. The models can connect upstream and downstream processes to evaluate various supply chain scenarios and options.

Argonne has developed three principal models for the TEA space:

- **Hydrogen Delivery Scenario Assessment Model (HDSAM)**—performs TEAs for hydrogen delivery to light-duty fuel cell electric vehicles (FCEVs) .
- **Hydrogen Refueling Station Analysis Model (HRSAM)**—performs TEAs for refueling light-duty FCEVs.
- **Heavy-Duty Refueling Station Analysis Model (HDRSAM)**—performs TEAs for refueling heavy-duty FCEVs.

In the Argonne TEA models, the hydrogen infrastructure is defined as being between the production gate to vehicle tanks, which covers transportation and distribution as one element (encompassing conditioning and compressing the hydrogen and delivering it to the city gate and within the city to the refueling station) and refueling (e.g., where the models consider whether the station is supplied by gas or liquid, its size, demand levels, etc.); hydrogen production is not part of the models.

HYDROGEN DELIVERY SCENARIO ANALYSIS MODEL (HDSAM)



Typical components examined in a Techno-Economic Analysis (TEA) of fuel delivery infrastructure.

THE IMPACT

Argonne regularly works with government agencies and industry to evaluate the viability of various fleet and other infrastructure-related investment decisions, becoming a trusted partner with a broad grasp on trends in hydrogen usage in other energy production modes: petroleum refineries, biofuels, ammonia plants, synthetic fuels and chemicals, pipeline injection, steel production, and light-, medium-, and heavy-duty vehicles.[1]

These capabilities can be deployed to address your particular scenario using a Techno-Economic Analysis or other of our analysis tools, including life cycle analyses, our GREET (Greenhouse Gas Emissions) software, and still other tools.

Visit the Energy System Division's Hydrogen Delivery Scenario Analysis Model site, where you can also access more than 20 TEA-related publications and reports produced by the TA Group since 2006.

CONTACT

Amgad Elgowainy
Senior Scientist / Electrification and Infrastructure Group Leader
Energy Systems Division
Phone: 630-252-3074
Email: aelgowainy@anl.gov

Michael Q. Wang
Manager, Systems Assessment
Energy Systems Division
Phone: 630-252-2819
Email: mwang@anl.gov
www.anl.gov/es

[1] See also: Elgowainy, A., M. Mintz, U. Lee, T. Stephens, P. Sun, K. Reddi, Y. Zhou, G. Zang, M. Ruth, P. Zadun, E. Connelly, and R. Boardman, 2020, *Assessment of Potential Future Demand for Hydrogen in the United States,* ANL/20-35, Argonne National Laboratory, National Renewable Energy Laboratory, and Idaho National Laboratory, October.