



Decision Sciences



ACTIONABLE INSIGHTS

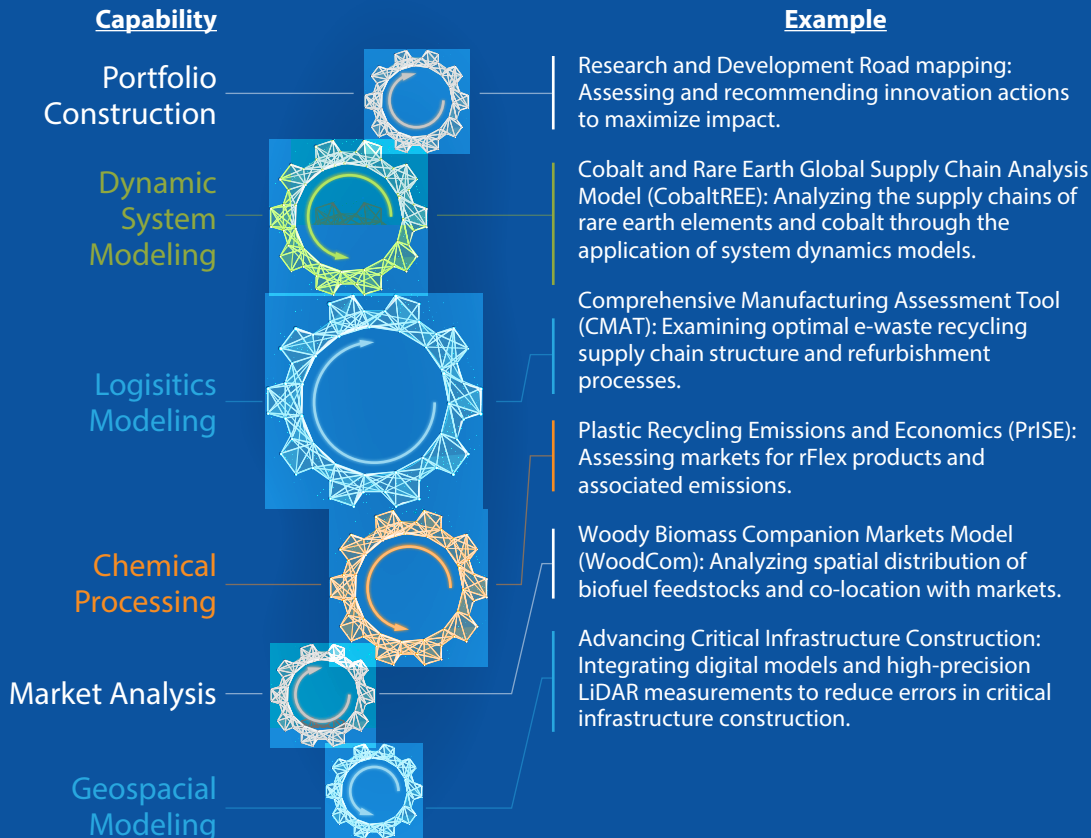
The Decision Sciences department at Idaho National Laboratory brings together experts in simulation modeling, geospatial analytics, digital engineering, operations optimization, economics and more. Our expertise in proven quantitative and qualitative methods enable us to produce context-informed insights for decision makers, providing valuable and actionable insight for clients across the energy landscape.

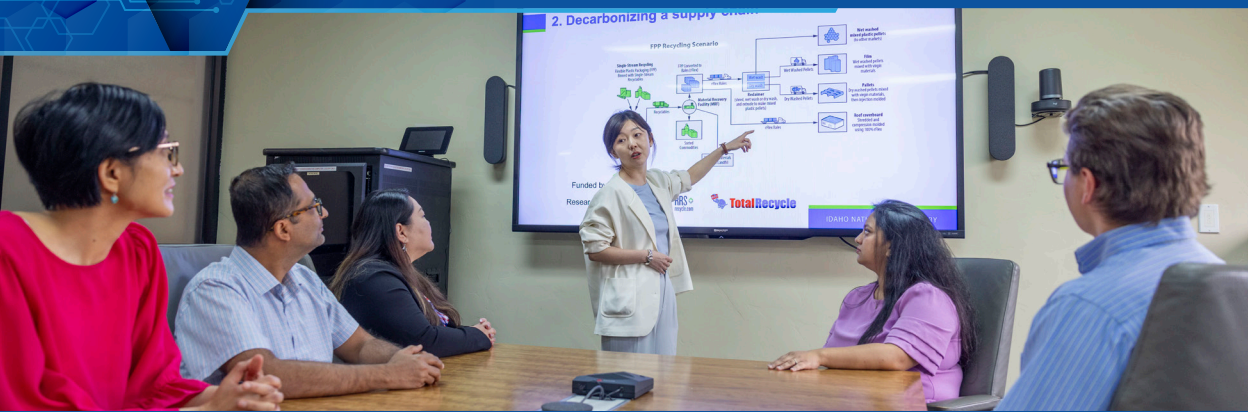
We inform the world's energy future by analyzing and optimizing supply chains, conducting experiments to understand the efficacy of policy actions in the real-world, and quantifying the constraints physical technologies must meet to scale-up.

We go beyond identifying “what” and “why” to provide stakeholders with insights into “how” and “when.” For example, we show how to effectively utilize existing infrastructure and resources to achieve a new objective and when to make strategic investments based on market trends, policy changes and technology advancements. We assess the impacts of uncertainty on potential outcomes to provide insights that are robust under a range of scenarios.

CORE CAPABILITIES

We leverage insights from mathematics, engineering, computer science, psychology, and economics to develop tailored tools using a combination of industry-accepted and novel methodologies.





AREAS OF EMPHASIS

Decision Sciences informs the world's energy future by providing policy-relevant insights within three areas of emphasis:

Improving Technology Development

- Scale up electric vehicle deployment by identifying bottlenecks and solutions.
- Analyze supply chains to identify viable technology research and development paths.
- Identify market opportunities and pathways to advance a circular economy.

Accelerating Deployment

- Improve e-waste recycling by testing intervention efficacy in context of state policies.
- Assess mechanisms to encourage farmers to grow energy crops.
- Reduce biofuel costs through regional logistics and supply chain optimization.

Enabling Better Operations

- Accelerate construction time by integrating real-time measurements with digital models.
- Improve biofuel production using situationally aware technoeconomic assessments.
- Improve recovery of irradiated sources through modeling and visualizing potential actions.

The following pages provide exemplar case studies aligned with each of these areas.

IMPROVING TECHNOLOGY DEVELOPMENT

Critical Materials Assessment

CONTEXT: The Critical Materials Assessment conducted an evaluation of materials to ascertain their significance to the supply chains of global clean energy technologies.

OUR ROLE: Decision Sciences performed the critical material supply chain risk evaluations.

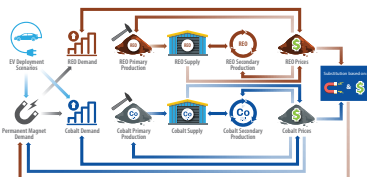
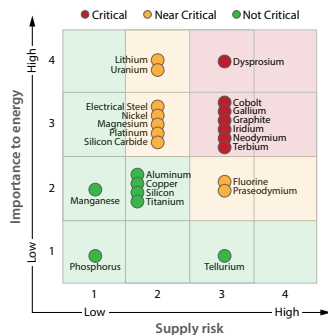
IMPACT: The Department of Energy (DOE) established the DOE Critical Materials List, identifying energy-specific critical and near-critical materials projected through 2035.

Supply Chain Impact Assessment of New Magnet Technology

CONTEXT: Demand for electric vehicle (EV) components, including batteries and rare earth traction motors, and the raw materials needed to make them, is expected to increase.

OUR ROLE: Decision Sciences developed a systems dynamic model to simulate supply chains.

IMPACT: Decision Sciences found that eliminating cobalt from magnet composition helps improve EV sales. Using non-permanent magnet motors has helped realize EV goals in early years.

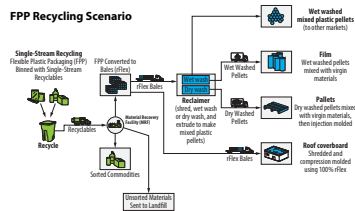


Implications of Scaling Up Flexible Plastic Packaging Recycling in the United States

CONTEXT: Plastic demand is increasing, and there is a corresponding need to ramp up collection and recycling.

OUR ROLE: Decision Sciences modeled flexible plastic packaging (FPP) recycling in the United States and investigated how downstream market dynamics can drive recycling.

IMPACT: This study found that recycled FPP from curbside collection is economically feasible and can reduce the carbon footprint.



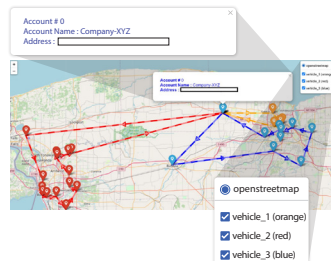
ACCELERATING DEPLOYMENT

Comprehensive Manufacturing Assessment Tool

CONTEXT: This initiative pinpointed pathways to lower the costs and energy associated with secondary feedstocks from recycled electronic waste.

OUR ROLE: Decision Sciences built a decision support framework to identify optimal routing, processing configurations and resource allocation, taking changing input and market conditions into consideration.

IMPACT: Decision Sciences showed how to create optimal routes to maximize truckloads, minimize fuel consumption, emissions, travel time, and distance, and we can visualize the economic performance for each type of e-waste.

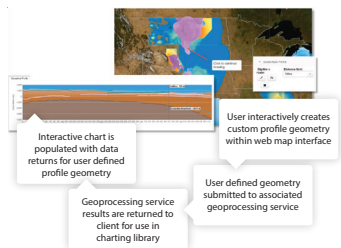


Web Map Application Development and Interactive Subsurface Cross-Sectional Profile Visualization of Geologic Host Rocks for Spent Fuel and Waste Disposition

CONTEXT: DOE's Office of Nuclear Energy's Spent Fuel and Waste Disposition campaign needed a map identifying underground facilities with disposal potential.

OUR ROLE: Decision Sciences built web-based geologic investigation tools with interactive visualization and a custom subsurface cross-section.

IMPACT: These tools have helped stakeholders and researchers make decisions for nuclear waste disposition and other subsurface investigations.

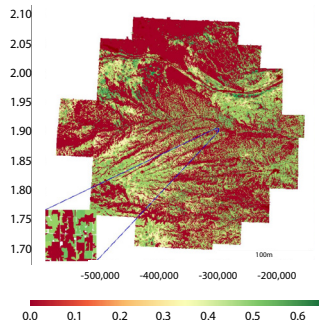


A Multi-Criteria Land Suitability Assessment of Field Allocation Decisions for Switchgrass Production

CONTEXT: For biomass for bioenergy to be sustainable, industry needs to identify fields suitable for growing energy crops, like switchgrass, while optimizing ecosystem services, carbon management, and long-term profitability, and reducing competition with commodity crops.

OUR ROLE: The Decision Science team designed and created a multi-criteria site suitability framework to analyze and estimate the biomass potential of a field.

IMPACT: The framework has provided county and state-level projects for biomass feedstock production and land suitability for energy crops.



ENABLING BETTER OPERATIONS

E-waste Collection Intervention Assessment

CONTEXT: The e-waste recycling project addressed the low recycling rate (15%) and the collection bottleneck. The project compared interventions in regulated New York and unregulated Idaho, focusing on community engagement and behavior change.

OUR ROLE: The team has organized e-waste collection events in Idaho and New York, conducted sociodemographic surveys, and educated students through school visits, collection contests and essay/video contests.

IMPACT: The project seeks to increase e-waste recycling rates, improve community awareness, and foster behavior change. Insights from comparing interventions in different states could inform future policies, while educational programs will promote recycling practices among students and their families.

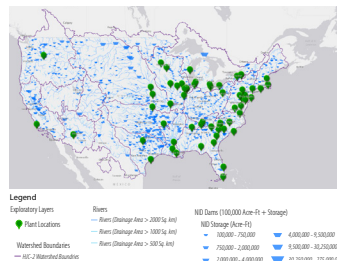


Flood Hazard Spatial Analysis for Nuclear Power Plants

CONTEXT: The US Nuclear Regulatory Commission (NRC) requested geospatial modeling and analysis to identify, locate, and map any dams upstream of active nuclear power plants. NRC needed to identify any dams that could be flood threats.

OUR ROLE: The team used datasets from the US Army Corps of Engineers and the US Geological Survey to find dams upstream of nuclear power plants and rank them based on distance and capacity.

IMPACT: The analysis identifies upstream dams near nuclear facilities and ranks them based on distance and storage capacity. The analysis interactively visualized identified dams and provided the information as cartographic output during the final presentation.

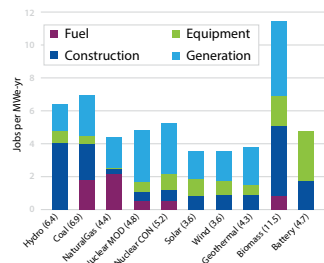


Energy Project Socio-Economic Impact Analysis

CONTEXT: The project quantified the economic impacts of new supply chain activity and community spending.

OUR ROLE: The team conducted a workforce analysis to understand education and training requirements and compare these across different technology deployment scenarios.

IMPACT: The findings helped quantify economic impacts, identify workforce needs, and guide future technology deployment and training programs.



CONTACT

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Impact assessment
- Business
- Community
- Macro-economic

Uncertainties
- Markets
- Policies
- World events

About Idaho National Laboratory

Battelle Energy Alliance manages INL for the U.S. Department of Energy's Office of Nuclear Energy. INL is the nation's center for nuclear energy research and development, and also performs research in each of DOE's strategic goal areas: energy, national security, science and the environment. For more information, visit www.inl.gov.

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