Center for Transportation Analysis

Shaping America’s mobility future

Oak Ridge National Laboratory
Managed by UT-Battelle for the Department of Energy
Shaping America’s Mobility Future

America’s leadership in sustainability and economic vitality relies upon a strong transportation system that meets the 21st century challenges of growing demand, energy security, and global climate change. Oak Ridge National Laboratory (ORNL) develops the necessary data for vehicle and transportation system architectures to empower the country in the decisions that advance these priorities. With a dual emphasis on vehicular platforms and large scale transportation systems, ORNL’s Center for Transportation Analysis (CTA) creates information, analytical tools, and methodologies that directly influence national policy and consumer choices.

At the vehicle scale, dramatic changes offer significantly better fuel economy and emissions control prompting aggressive research in integrated combustion engines and hybrid electric powertrains. ORNL’s role in the Department of Energy’s (DOE) Advanced Vehicle Systems program includes prototype research and characterization of advanced systems under development. An important element of CTA is accelerating the pace to help shape the architecture of future vehicles.

CTA’s Impact on U.S. Transportation Sector

Energy

Because 97% of fuel in the transportation sector is derived from oil, the US invests heavily in more energy efficient and environmentally friendly highway transportation technologies that enable reduced petroleum dependency. CTA promotes smart decision-making across the board with key data that has been relied upon year after year, and by investigating advanced integrated powertrains and platforms.

Mobility

Each year, major congestion causes urban Americans to lose productivity and consume more gallons of fuel, yielding significantly increased transportation costs. CTA’s analysis of congestion origins, factors, and solutions is paving the way to resolving this elusive drain on the nation’s economy.

Safety

In 2011, the US experienced 29,757 fatal crashes, resulting in 32,367 total deaths. Identifying travel behavior trends, accident causation patterns, and transportation demographics for both passenger and freight vehicles advances preventative action to mitigate property damage, injuries, and deaths. CTA plays a key role in data collection, analysis, and new technologies that makes for safer roads and vehicles.
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SUCCESS STORY

What began as a platform for fulfilling the responsibility of DOE and the Environmental Protection Agency (EPA) to provide accurate miles per gallon information to consumers (under the Energy Policy Act of 1992) has evolved into one of the US government’s most visited websites: FuelEconomy.gov. Launched in October 1999, FuelEconomy.gov is widely recognized as the leading web-based tool to find fuel economy estimates, energy and environmental impact ratings, fuel-saving tips, and other useful information. CTA generates the site’s data that empowers consumers who contribute to the 15 million vehicles sold domestically on average each year. At 48 million user sessions annually, FuelEconomy.gov is estimated to have reduced US petroleum consumption by more than 928 million gallons in 2012. The dynamic, user-friendly analytical tool was cited in the media 1,250 times in 2012 by national outlets such as the New York Times, USA Today, NBC news, CBS news, Consumer Reports, and the Wall Street Journal.

CTA engages in field and laboratory research that informs and shapes national clean energy policy, and the implementation of new powertrain concepts through transportation data, innovative models, comprehensive analysis and simulation, and advanced vehicle systems integration.

EXCELLENCE IN ENERGY

Capabilities and Program Areas

- Forecasting of transportation energy trends
- Fuel economy studies
- Advanced powerpack and hardware-in-the-loop testing
- Simulation and modeling of energy sources, end usage, and economics
- Vehicle usage data
- Technology development and validation in the laboratory and in the field
- Transportation technology market analysis
- Systems-level integration and evaluation
SUCCESS STORY

Throughout the country, the US transportation system moves an average of more than 50 million tons of freight at an estimated value of $45 billion every day using all modes of transportation. The Department of Transportation’s Federal Highway Administration (FHWA) depends on CTA’s extensive experience and knowledge of the US freight network, modeling and analytics, database management, and application development to create the Freight Analysis Framework (FAF). FAF is a robust database, developed in collaboration with FHWA, that houses the most comprehensive representation of multi-modal freight flows by mode and commodity, both domestically and internationally. National, state, and local policy makers and transportation planners in the public and private sectors rely on FAF as a critical tool in making educated decisions in the planning, operation, investment, and asset management of America’s freight system. Known as the most comprehensive, publicly available database of freight movements, FAF provides accurate estimates for tonnage, value, and ton-miles by origin, destination, mode, and commodity type.

Excellence in Mobility

Capabilities and Program Areas

- Decision engineering
- Predictive analytics
- Supply chain logistics
- Development of information portals
- Data mining
- Simulation and optimization
- Multi-modal network modeling
- Operations research
- Economics
- Statistical analysis and modeling
- Geospatial visualization tools
SUCCESS STORY

With more than six million commercial trucks and buses traveling over 200 trillion miles annually, the challenge for state and federal enforcement agencies to ensure commercial vehicles, their drivers, and passengers are operating in a safe and compliant manner can be daunting. The Federal Motor Carrier Safety Administration (FMCSA) sought to address this safety concern by utilizing CTA’s expertise in commercial motor vehicle operations and technology evaluation to determine the viability and effectiveness of an FMCSA-funded infrared-based screening system (IBSS). IBSS is an innovative roadside screening technology that provides a safer and more efficient way for law enforcement to monitor and ultimately place out of service commercial vehicles with brake and tire defects. CTA took the IBSS through proof of concept and pilot and field operational testing, making improvements to the technology with each series of evaluation. Once testing was completed, CTA validated IBSS’ success. Of the vehicles flagged by IBSS, 80% were found to have vehicle defects, a high confidence rate for law enforcement to use IBSS as an effective screening tool. Developed by International Electronic Machines Corporation, this technology was licensed and branded as the SIRIS™ Infrared Inspection system and is currently implemented along participating Commercial Motor Vehicle Roadside Technology Consortium interstate highways.

Excellence in Safety

Capabilities and Program Areas

- Data analytics
- Evacuation modeling
- Simulation and optimization modeling
- Infrastructure inspection support
- Technology demonstrations
- Unique multi-state, real-world test bed
- Risk assessment
- Program evaluation and performance measurement
- Geospatial information systems and visualization
- Extensive network of public/private partnerships
RESEARCH & DEVELOPMENT FACILITIES
VEHICLE SYSTEMS INTEGRATION LABORATORY
Rising transportation fuel costs and clean air regulations have increased the focus on vehicle fuel efficiency and emissions control, highlighting a need for more aggressive research into advanced powertrain technologies. Developing technologies that meet the requirements of integrating these novel designs can be taxing on limited budgets and engineering resources. The Vehicle Systems Integration (VSI) Laboratory was created to accelerate the pace of powertrain development by performing prototype research and characterization of advanced systems and hardware components. In doing so, the VSI Lab contributes to the larger CTA mission of supplying the foundational data needed to define future vehicle architectures.

The VSI Lab is capable of accommodating a range of platforms from advanced light-duty vehicles to hybridized Class 8 powertrains with the goals of improving overall system efficiency and reducing emissions. CTA’s affiliation with the VSI Lab illustrates its connection to science-based knowledge discovery in fuels, engines, and emissions research and power electronics and electrical power systems research, cultivating the rich diversity of interfaces among them. Coupling these state-of-the-art research assets with the corresponding data analytics, visualization, and domain expertise in CTA offers a powerful capability for producing results that matter.
CTA brings complex data sets to life in the Transportation Analysis and Visualization Laboratory (TRAVL), a state-of-the-art, 32-seat facility designed to showcase ORNL-developed transportation modeling and simulation tools. With enough processing power for 15 high-definition 3D graphics panels, TRAVL is a signature asset for CTA’s contemporary research activities in transportation data visual analytics. It facilitates researchers’ requirements to present the most advanced real-time simulation modeling collaborations and visual sharing of data displayed as topographical maps, 3D drawings, and high-definition video. TRAVL excels at illustrating vision-based solutions for challenges CTA is working to solve.

CTA operates a roadside technology laboratory that comprises a series of specially equipped research facilities at inspection stations to demonstrate, analyze, evaluate, and showcase innovative commercial motor vehicle safety technologies for the FMCSA. The inaugural 70-mile corridor located in Tennessee was commissioned in 2007 as the Commercial Motor Vehicle Roadside Technology Consortium (CMVRTC). The CMVRTC is the only permanent test bed in the US to field test current, new-to-market, and emerging safety technologies in a real-time environment, and it continues to expand as more states participate with the goal of eventually establishing a nationwide roadside laboratory network.
**Signature PRODUCTS AND PROJECTS**

**FuelEconomy.gov**
FuelEconomy.gov is an online resource that helps consumers make informed choices when purchasing a vehicle and achieve the best fuel economy possible from the cars they own.

**Vehicle Technologies Market Report**
Vehicle Technologies Market Report details the major trends in US light-duty vehicle and medium/heavy truck markets, as well as the underlying trends that caused them, highlighting the progress of high-efficiency and alternative fuel technologies.

**National ITS Deployment Survey and Tracking**
National ITS Deployment Survey and Tracking activities include periodic surveys taken of metropolitan and rural areas and the Intelligent Transportation Systems (ITS) Asset Viewer that visually displays locations of traffic cameras, roadway dynamic message signs, weather condition, and vehicle sensors across the US.

**Transportation Energy Data Book**
Transportation Energy Data Book includes statistics and other information that characterize transportation activity and/or influence transportation energy use.

**CTA North American Routing Transportation Network**
CTA North American Routing Transportation Network is a geographically based link-node that shows networks of major roadways and all active railroads for routing, traffic assignment, investment, and reliability analyses in the US, Canada, and Mexico.

**National Household Travel Survey**
National Household Travel Survey data are collected every five years from a sample of US households to provide national estimates of trips and miles by travel mode, purpose, and a host of other characteristics and information on daily, local, and long-distance travel.

**Partnerships & Collaborations**

**Government Sponsors**
- US Department of Energy
- US Department of Transportation
  - Federal Highway Administration
  - Federal Motor Carrier Safety Administration
  - Research and Innovative Technology Administration
- US Department of Defense
- US Department of Homeland Security
- Federal Emergency Management Agency
- US Environmental Protection Agency
- Bureau of Census
- National Aeronautics and Space Administration
- State departments of transportation
- Local planning organizations
- National Research Council
- Academic partners

In recent years, CTA has worked in collaboration with more than 40 private sector companies who serve in leadership positions within the transportation sector.
Drawing on nearly 40 years of experience, CTA excels as a proven leader in all aspects of transportation systems solutions that enables and helps ensure a more secure energy and environmental future. Specializing in passenger and commercial highway realms, CTA’s robust and rigorously maintained databases and resources:

**Impact energy efficiency and fuel economy**
- Bioenergy lifecycle modeling
- Domestic petroleum and energy security
- Planning for deployment of fuel cell vehicles and hydrogen refueling infrastructure
- Truck technology efficiency assessment
- Market Acceptance of Advanced Automotive Technologies (MA²T) model
- 25% mass reduction study
- New York City electric taxi cab performance
- Carbon fiber cost modeling
- Methodology to estimate national fuel economy rates (miles per gallons)
- US Postal Service electric vehicle delivery truck testing
- Green Racing

**Increase the mobility of people and goods**
- Intelligent transportation systems deployment tracking and viewer
- Geo Freight: A GIS-based decision support tool
- Congestion pricing study
- Safeguarding truck-shipped wholesale and retail fuels
- Inland waterway navigation investment analysis planning model
- National Household Travel Survey (1997-current)
- North American intermodal routing network

**Improve system safety**
- Motorcoach safety—policy and process review
- Commercial motor vehicle technology field operational tests
- Pipeline safety assessments and analyses
- Routing of hazardous materials
- Tracking of certain dangerous cargo barges on inland waterways
- RailReady: Geospatial analysis tool for rail infrastructure protection
- Oak Ridge evacuation modeling system
- ORNLReady: Web-based geospatial visualization tool for emergency management and response
- Brake defect causation and abatement study
- Heavy overweight vehicle brake testing
Wartime Support

ORNL’s transportation analysis research team was commissioned by the US Air Force (USAF) in 1986 to create the Airlift Deployment Analysis System (ADANS), an automated system to provide USAF with planning, scheduling, and analytical tools for peacetime and contingency airlift operations. Originally slated for completion in October 1992, the ADANS project was thrust into action following the August 2, 1990 Iraqi invasion of Kuwait – the beginning of the first Gulf War.

The ORNL ADANS team went beyond what is normally expected of researchers when deploying the ADANS system to airlift planners in support of Operation Desert Shield. ADANS became the exclusive airlift planning and scheduling system, contributing to Operation Desert Shield’s success as the most effective airlift operation in recent history. USAF officers recognized ORNL and awarded the ADANS team as a major factor in the US’s ability to win that war. Today, CTA continues to support ADANS and the tradition of using its capabilities on significant Department of Defense and Department of Homeland Security projects.

Nobel Peace Prize

Dr. David L. Greene, an esteemed transportation planning and decision science analyst for ORNL from 1979 to 2013, was recognized by the Intergovernmental Panel on Climate Change (IPCC) for contributions to the IPCC’s receipt of the 2007 Nobel Peace Prize. Dr. Greene was a lead author for the Transport chapter of the IPCC Fourth Assessment mitigation report.
The Center for Transportation Analysis is located at the National Transportation Research Center, an ORNL-DOE user facility. For more information please contact:

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