



UNITED STATES  
DEPARTMENT OF TRANSPORTATION

# AERIS State of the Practice Assessment: Applications

## *Summary Findings*

Prepared by Noblis on behalf of the  
USDOT Applications for the Environment: Real-Time  
Information Synthesis (AERIS) Program

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**AERIS**

**Sponsored by the ITS Joint Program Office, Research and Innovative  
Technology Administration (RITA).**

# Overview

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- Purpose
- Scope
- Application Assessments
- Conclusions and Questions Raised

# Purpose of the Report

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- Document the current state of the practice for applications that have demonstrated environmental benefits through intelligent transportation systems (ITS) technologies, or have the potential to do so
- Identify opportunities for AERIS to leverage existing research
- Assist USDOT in planning and implementing the AERIS Program



# Scope of the Report

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- Broad scan of published literature
  - Domestic and international
  - Conference proceedings
  
- Vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I) communications
  
- Transportation modes
  - Passenger, freight, and transit vehicles
  
- Environmental benefits
  - Reduce greenhouse gases (GHG)
  - Reduce criteria air pollutants
  - Reduce fuel consumption



# Application Assessments\*

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- Application Categories
  - Demand and Access Management
  - Eco-Driving
  - Traffic Management and Control
  - Logistics and Fleet Management
  - Freight
  - Transit
  - Other

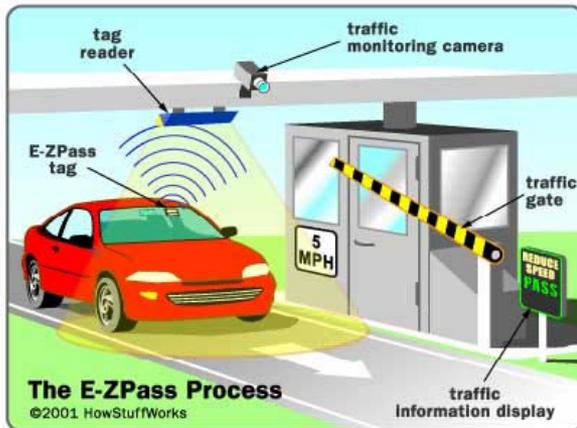
\*References do not constitute endorsement of any product, service, organization, company, information provider, or content.



# Demand and Access Management

*Aim to reduce travel demand by controlling access to roadways, improving pedestrian and transit options, and encouraging policies that reduce demand at peak hours.*

## Electronic Toll Collection



## Congestion Pricing



## Mileage Based Fees



# Demand and Access Management

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- Findings
  - **Electronic toll collection (ETC)** systems in the United States have demonstrated the ability to reduce emissions 265,000 metric tons carbon equivalent (MTCE) annually, which is equal to removing 50,669 vehicles from the roadway annually.
  - **Congestion pricing** strategies employed internationally have shown the ability to reduce particulate matter (PM) up to 20%, reduce carbon dioxide (CO<sub>2</sub>) up to 14%, reduce nitrogen oxide (NO<sub>x</sub>) up to 15%, and reduce the number of days that exceed air quality standards.
  - While the acceptance of **mileage based fees** in the United States has not yet been determined, pilot projects have reduced vehicle miles traveled (VMT) up to 13%, which in turn can reduce fuel consumption and emissions.



# Eco-Driving

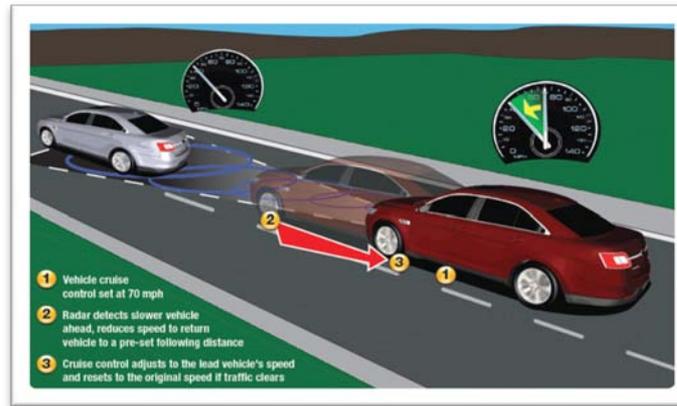
*Target individual drivers with the objective of promoting a driving style that lowers vehicle emissions.*

## Eco-Driving Assistance



Source: [www.howwedrive.com](http://www.howwedrive.com)

## Adaptive Cruise Control (ACC)



Source: [media.ford.com](http://media.ford.com)

## Eco-Routing



Source: [www.gpsmagazine.com](http://www.gpsmagazine.com)

# Eco-Driving

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- Findings
  - **Eco-driving assistance** studies and pilot projects have shown the potential to reduce CO<sub>2</sub> emissions up to 15%.
  - Domestically and abroad, **ACC** pilot projects documented fuel reductions up to 10% and CO<sub>2</sub> and NO<sub>x</sub> reductions of 3%. PM increased by 3% in one of the pilots.
  - Navigation systems with **eco-routing** features have assisted drivers in improving fuel economy up to 15%.



# Traffic Management and Control

*Provide the ability to analyze current traffic conditions and dynamically adjust to accommodate different types of traffic or changing conditions.*

## Incident Management Systems



## Ramp Metering



## Speed Management



## Adaptive Signal Control



## Signal Coordination & Optimization



# Traffic Management and Control

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- Findings

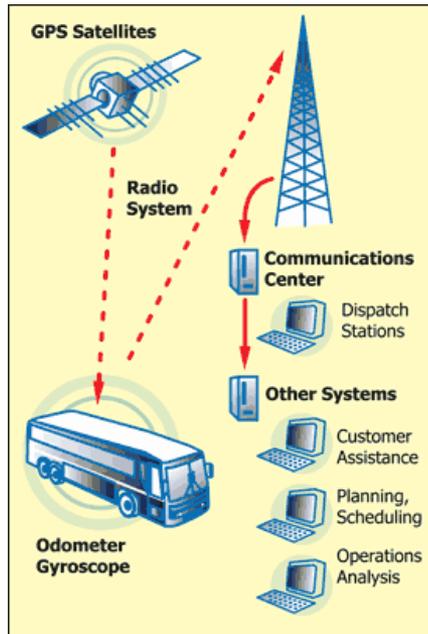
- Studies show that integrating traveler information with **incident management systems** can reduce emissions an additional 3% and improve fuel economy by 1.5%. Incident management programs around the United States have documented fuel savings of up to 6.83 million gallons per year.
- Studies in Minnesota proved that **ramp metering** projects in that state have reduced emissions by 3 to 8%. Without ramp metering, emissions increase annually by 1,160 tons. However, ramp metering can have negative impacts on high demand days.
- **Speed management** applications can decrease NO<sub>x</sub> emissions by up to 17% through the use of variable speed limits and up to 25% by reducing speed limits.
- **Adaptive signal control** can reduce emissions up to 50% for travel in the direction favored by the signal. Travel in the direction that is not favored by the signal can increase emissions up to 9%.
- **Traffic signal coordination and optimization** can reduce emissions up to 22% and has a 40:1 return on investment.



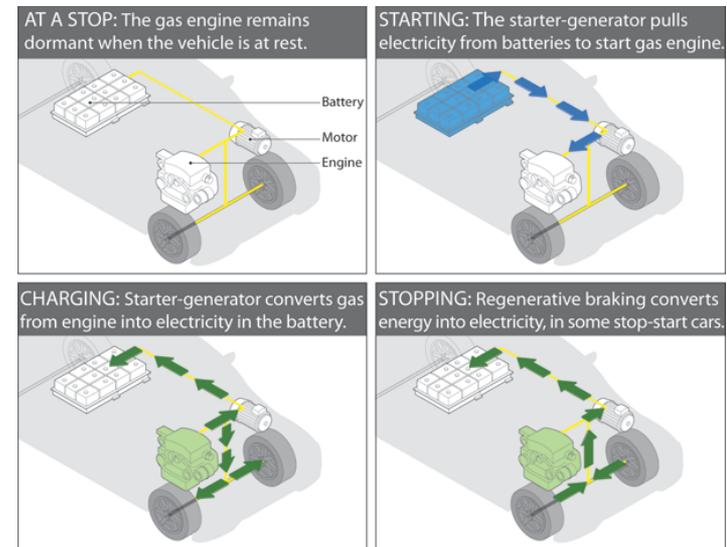
# Logistics and Fleet Management

*Reduce emissions through services that optimize vehicle maintenance, telematics, and driver, speed, and fuel management.*

## Automated Vehicle Location (AVL) Systems



## Idle-Off Stop-Start Systems



Source: [www.hybridcars.com](http://www.hybridcars.com)

# Logistics and Fleet Management

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- Findings
  - **AVL systems** can assist in optimizing routes, which can reduce VMT, and therefore, emissions. One AVL technology solution eliminated 44,000 pounds of GHG emissions annually from the City of Napa's vehicle fleet.
  - **Idle-off stop-start** systems can reduce emissions up to 20% in urban environments, and idle reduction technologies for freight rest stops have demonstrated the ability to reduce emissions by 83%.



# Freight

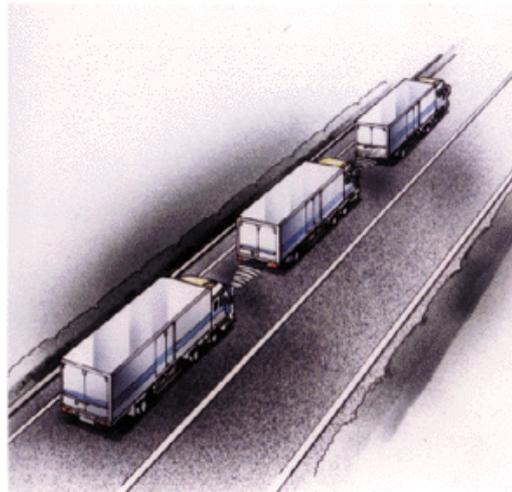
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*Reduce freight emissions through the exchange of information that allows for more efficient management of freight travel and delivery.*

## Delivery Management



## Platooning



Source:  
<http://www.geekyblogger.com/2008/06/automated-highway-system-ahs.html>

## Freight Eco-Driving



Source: [www.shiotsu-used-car.com](http://www.shiotsu-used-car.com)

# Freight

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- Findings
  - United Parcel Service (UPS) **delivery management** initiatives have helped the company to reduce fuel consumption by 3 million gallons and eliminate 32,000 MTCE per year.
  - **Platooning** freight vehicles research has shown the potential to reduce fuel consumption by 10 to 20%.
  - A Swedish trucking company reduced its fuel consumption by 5 to 20% using a real-time **eco-driving** performance monitoring system. The system provided truck drivers with real-time feedback and tips with the goal of improving their fuel economy.



# Transit

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*Reduce transit emissions through the exchange of information that allows for optimization of transit travel and mode shift.*

## Transit Signal Priority (TSP)



Source: [www.sfbayite.org](http://www.sfbayite.org)

## Bus Rapid Transit (BRT)



Source: [www.arrivealive.co.za](http://www.arrivealive.co.za)



# Transit

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- Findings

- **TSP** studies conducted in England reported that bus emissions were reduced up to 30%, but non-transit vehicle emissions increased up to 11%.
- FTA research found that **BRT** elements can create a 25% transit travel time savings in the United States, potentially increasing ridership and therefore reducing VMT and emissions.
- Researchers in China found that road segments with **dedicated bus lanes** have 10% less emissions of NO<sub>x</sub>, carbon monoxide (CO), and PM compared to road segments without dedicated bus lanes.



# Other Applications of Interest

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*Other applications of interest with the potential to create environmental benefits through ITS applications.*

## Bicycles Used As Field Probes



Source:  
<http://senseable.mit.edu/copenhagenwheel/>

## Parking Management Systems



Source: [www.spectrum.ieee.org](http://www.spectrum.ieee.org)



# Other Applications of Interest

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- Findings
  - **Bicycles used as field probes** can collect and share fine scale, real-time environmental data and enable cities to make better transportation and environmental policy decisions.
  - **Parking applications** that provide information to drivers on the location of available parking spaces can halve the time spent searching. It is reasonable to assume that reduced time spent searching for an available space can also reduce fuel consumption and emissions.



# Conclusions and Questions Raised

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- Some environmental benefits of ITS applications have been documented, but many questions remain.
- Varying levels of environmental benefits are documented.
  - Would combining applications provide greater environmental benefits? Reduced benefits? Perhaps both, depending on certain factors?
- International communities have seen significant environmental benefits from applications that require policies, such as congestion pricing and low emissions zones in London.
  - What is the potential for such policies to be put into place in the United States? Could they be as effective given the different geographic landscape and scale?
- Most mobility applications can likely reduce emissions and fuel consumption (e.g., adaptive cruise control or transit signal priority).
  - However, emissions and fuel consumption can also be reduced by strategies that can negatively impact mobility or productivity.



# Conclusions and Questions Raised (cont'd)

- What are the minimum environmental benefits that are acceptable for an individual application and/or a portfolio of applications, and by geographic scale (i.e. national, regional, corridor, or local)?
- Data documenting the environmental benefits of ITS applications are presented in various metrics and formats. In order to accurately compare applications in terms of environmental benefits, a common metric and format will need to be used.
- What environmental benefits can be achieved with the implementation of V2V and V2I?
- Can ITS applications provide benefits for both local emissions hot spots and global GHG emissions?
  - Can small GHG emissions reductions in many localized areas provide national and global benefits? At what geographic scale?



# Next Steps

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- Conduct interviews
- Review unpublished research
- Monitor Broad Agency Announcement (BAA) research projects' results
  - AERIS Program funded seven organizations

# Thank You!

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