

**AERIS: Intellidrive<sup>SM</sup> for the Environment**  
Applications for the Environment: Real-Time Information Systems  
***Data Needs and Performance Measures***

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Special Session 14: “How Do You Measure ‘Sustainability’ –  
Performance Measures for transportation and Climate Change

*Tuesday, May 4, 2010*

*10:30am-12:00pm*

*ITS America Annual Meeting, Houston, TX*

# What is IntelliDrive<sup>SM</sup>?

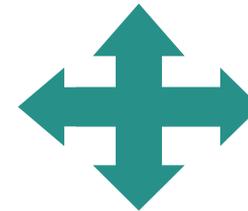
- IntelliDrive<sup>SM</sup> is a suite of technologies and applications that use **wireless communications** to provide **real-time connectivity**:
  - Among vehicles of all types
  - Between vehicles and roadway infrastructure
  - Among vehicles, infrastructure and wireless consumer devices
  - To all system users/operators
  - Applications
    - Safety
    - Mobility
    - Environment



•Drivers



•Vehicles



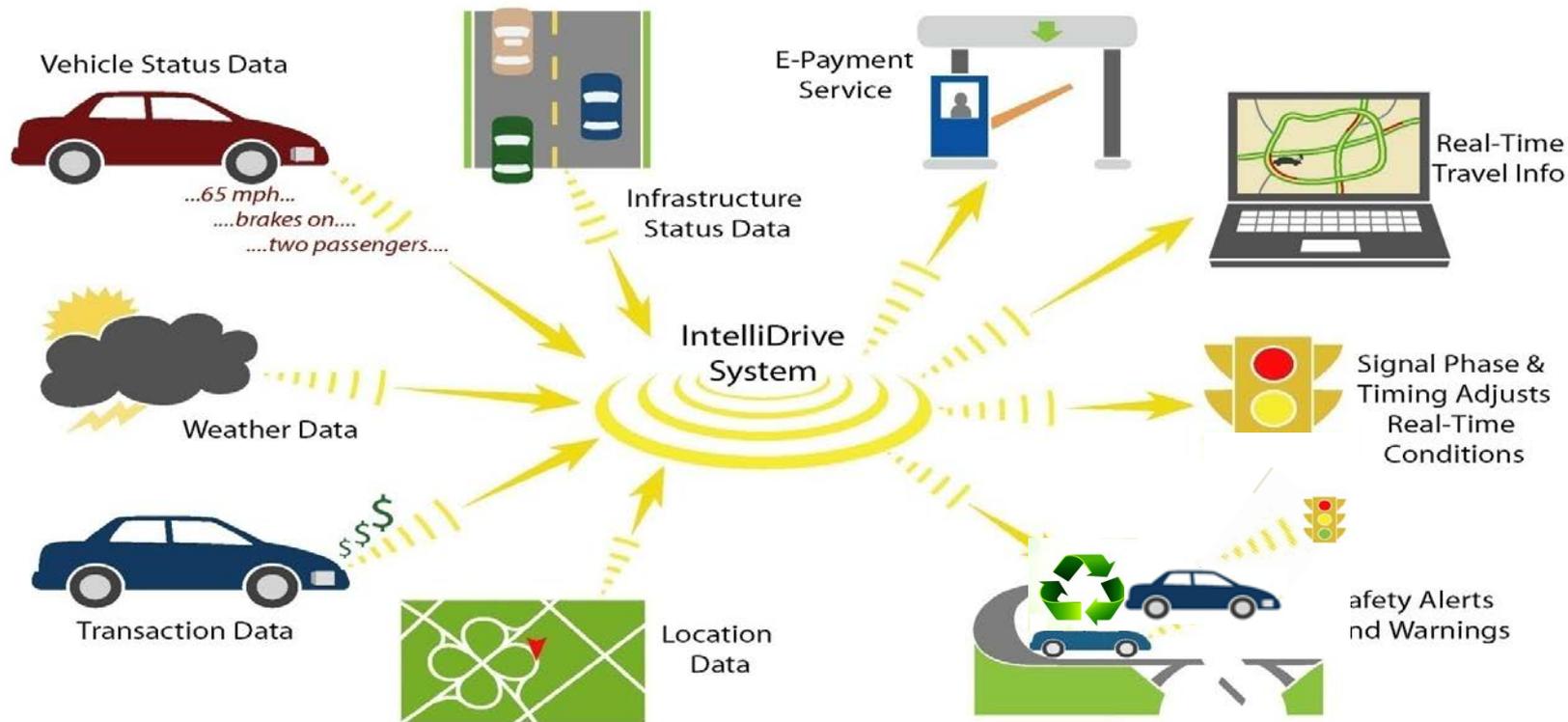
•Infrastructure



•Wireless  
•Devices

# Networked Environment

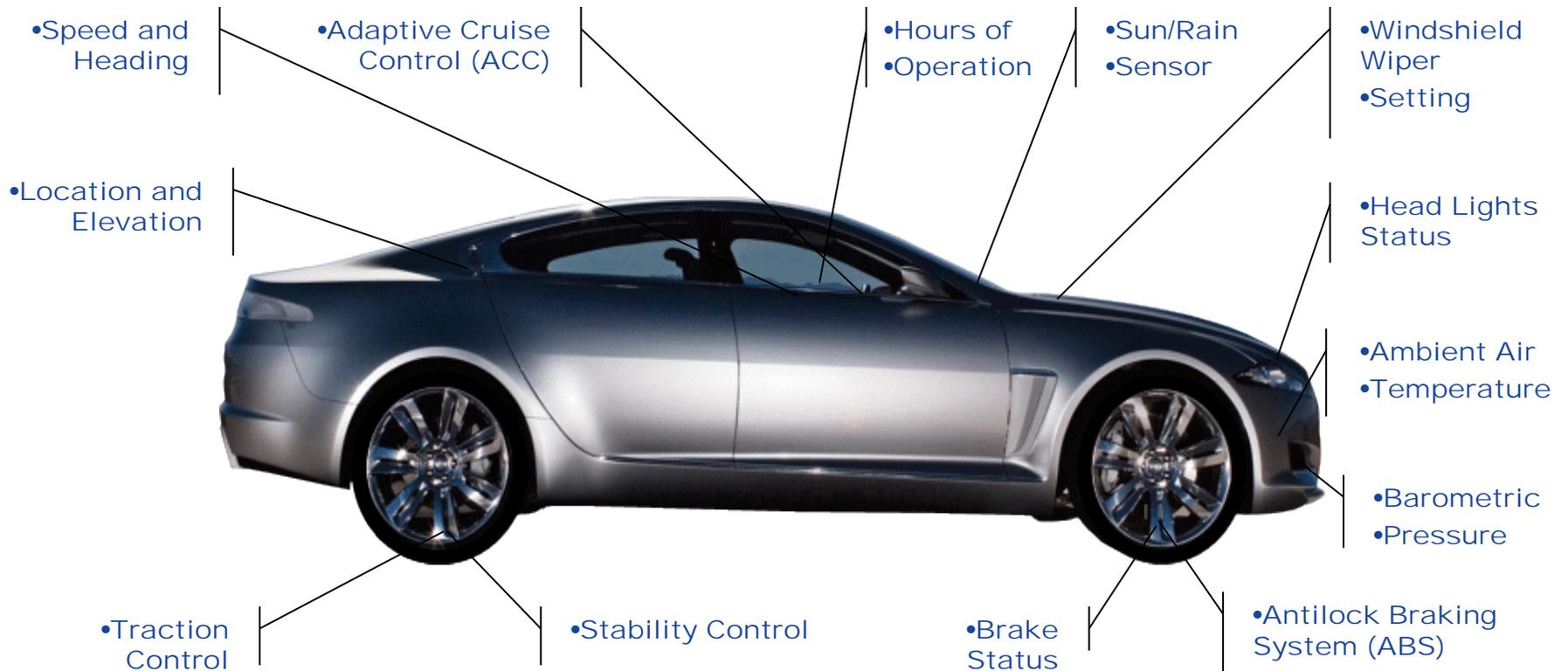
## IntelliDrive<sup>SM</sup> Networked Environment DATA IN, ACTIONABLE INFORMATION OUT



# Vehicle-Based Data: Examples

## *Imagine:*

- Managing the system with specific information about vehicle operations.



# AERIS: Setting Some Context

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- AERIS is a **new direction** for the ITS JPO
- In the process of **educating ourselves**
- Research **scope and program is forming**
- **Depending on the ITS community** to help form and inform
- Team is **multimodal**
  - FHWA (TFHRC, HEP, HOFM)
  - NHTSA
  - FTA
  - FMCSA
  - OST
  - Seeking other modes if interested (MARAD, FRA?)
- **Today, we want your input.**

# Why AERIS?

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## Environmental Problem

- 2.9 billion gallons of wasted fuel each year – 3 weeks worth of gas for every traveler
- Transport approx 28% of US GHG;
- Vehicles 80% of this slice of pie

## Environmental Goal

- ↓Emissions ↓Greenhouse Gases
- ↓ Particulates:
  - Enable better environmental management through connectivity
  - Enable traveler choice for eco-friendly options



# What Can ITS Do?

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- Many strategies available to reduce transportation's percentage contribution to GHG
  - Vehicle improvements (zero-carbon or near-zero-carbon vehicles)
  - Fuel improvements
  - Reductions in VMT
  - Operational improvements to the system as a whole
  - Improvements in operating efficiency of individual vehicles
- **ITS can contribute – \*we think\***
  - Need to quantify and prove
- Our job is to figure out **how ITS may contribute to GHG reductions and how much, in an IntelliDrive<sup>SM</sup>-enabled future.**

# Background

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- AERIS research **scoped with extensive stakeholder input**, including **Departmental leadership**
- AERIS **Charter** signed mid-March
  - Finally ready to move forward
- Now in the process of refining the roadmap, articulating exactly **what we plan to do, how we plan to do it, when, and with whom**



# Knowledge Gaps for Environmental Data and ITS: Opportunities to Learn

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- Need to look at the **existing transportation system data**, and the cutting edge of **communication and data exchange** between vehicles and between vehicles and infrastructure (and vice versa), and see if there are a handful of **applications or scenarios** that provide a **significant environmental benefit as a consequence of employing IntelliDrive<sup>SM</sup>**.
- We are just **beginning the effort to extensively test V2V and V2I communications and data exchange**, and looking at developing applications for safety, mobility, and environment.
  - For the environment, research is underway, but much **more needs to be understood, modeled, tested and evaluated**, especially in **real-world situations at a larger scale**.

# Knowledge Gaps for Environmental Data and ITS: Opportunities to Learn (cont'd)

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- Need to **leverage and expand opportunities** for public, private and academic sector application development and research by developing new data sets and **new opportunities for data** use, focused on using **public infrastructure**.
- Opportunity to take a **multi-modal approach** to research: **all types of vehicles (cars transit, trucks, etc.) must be examined**
  - This is **critical to the success** of AERIS.
- **Understanding of data issues, evaluation techniques and performance measurement critical as well.**



# AERIS: Research Goal and Objectives

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- **Ultimate “Stretch” Goal**

- **Transform** environmental management of the transportation system.

- **Objectives**

- To investigate whether it is **possible and feasible** to generate/capture **environmentally-relevant real-time transportation data** (from vehicles and the system), and use this data to create **actionable information** that can then be used by system **users and operators** to support and facilitate **“green” transportation choices for all modes**.
- **Assess** whether doing these things yields a good enough environmental benefit to **justify further investment**.



# **\*\*Examples\*\* of “Green Choices” for System Users and Operators**

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- Eco-driving using signal phasing and timing (SPaT)?
- Integrated Corridor Management (ICM)-like system able to optimize for environmental factors?
- Work zones, incident management, special event applications?
- Parking applications?
- Transit and freight applications?
- Pricing applications?
- Others?
- “Next-Generation”?



# AERIS Research Questions

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- Three overarching questions:
  - **Data**
    - What vehicle-based data is available, and what is its quality and validity? (All types of vehicles) **(More on this later)**
  - **Information/Connectivity**
    - How can vehicle-based data be used and integrated with existing transportation system operation and other data (such as road weather data, for example)?
  - **Benefit**
    - What cross-modal public-sector oriented applications/strategies are available, or could be available/developed, and what are their expected benefits?



# How Do We Envision Success?

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- Success will be measured by progress on:
  - **Development and execution of an extensive foundational research program** that will inform application and strategy development by both the public and private sectors.
  - **Identification of the most effective and promising technological solutions** that merit future research investment.
  - **Evaluation of data/technology gaps**
  - **Use of ITS data to improve models**
  - **Providing fertile ground for public and private sector application** development



# AERIS Research Program: Six Tracks/Five Years

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- **Track 1: Establish the Foundation** by comprehensively reviewing the **state-of-the practice** to:
  - Determine the limits of current technology and **available data sets**.
  - Identify the limits and challenges of monitoring and analysis, including a **review of existing models** and algorithms.
  - Examine **where ITS technologies and data can be most effective** and contribute maximum value to addressing environmental impacts.
  - Use existing models to **initially explore** the effectiveness of improvement strategies.



# AERIS Research Program: Six Tracks/Five Years

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- **Track 2: Identify initial candidate strategies and applications** that appear to improve environmental decisions by public agencies and travelers.
  - **Characterization and screening** of applications/strategies
  - **Assessment** of the technology and data gaps
  - Initial cost-benefit analysis and “**down-selection.**”



# AERIS Research Program: Six Tracks/Five Years (cont'd)

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- **Track 3: Analyze and evaluate candidate strategies and applications** that make sense for further development and evaluation based on the expectations of their potential contributions.
  - Identification and **analysis of evaluation tools** and baselining of tools for measuring and evaluating applications and scenarios
    - **Build a robust evaluation process**
  - Conduct **gap analysis** with respect to models and data; attempt to fill gaps
  - Conduct **in-depth evaluation** and benefit/cost analysis



# AERIS Research Program: Six Tracks/Five Years (cont'd)

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- **Track 4: Recommend strategies and applications**
  - Based on cost/benefit analysis, but also: risks and opportunities, existence of enabling technologies, acceptance of public/stakeholders, feasibility of deployment, and **appropriateness of further DOT support**
  - Development of *Research Investment Plan* in consultation **with stakeholder community.**



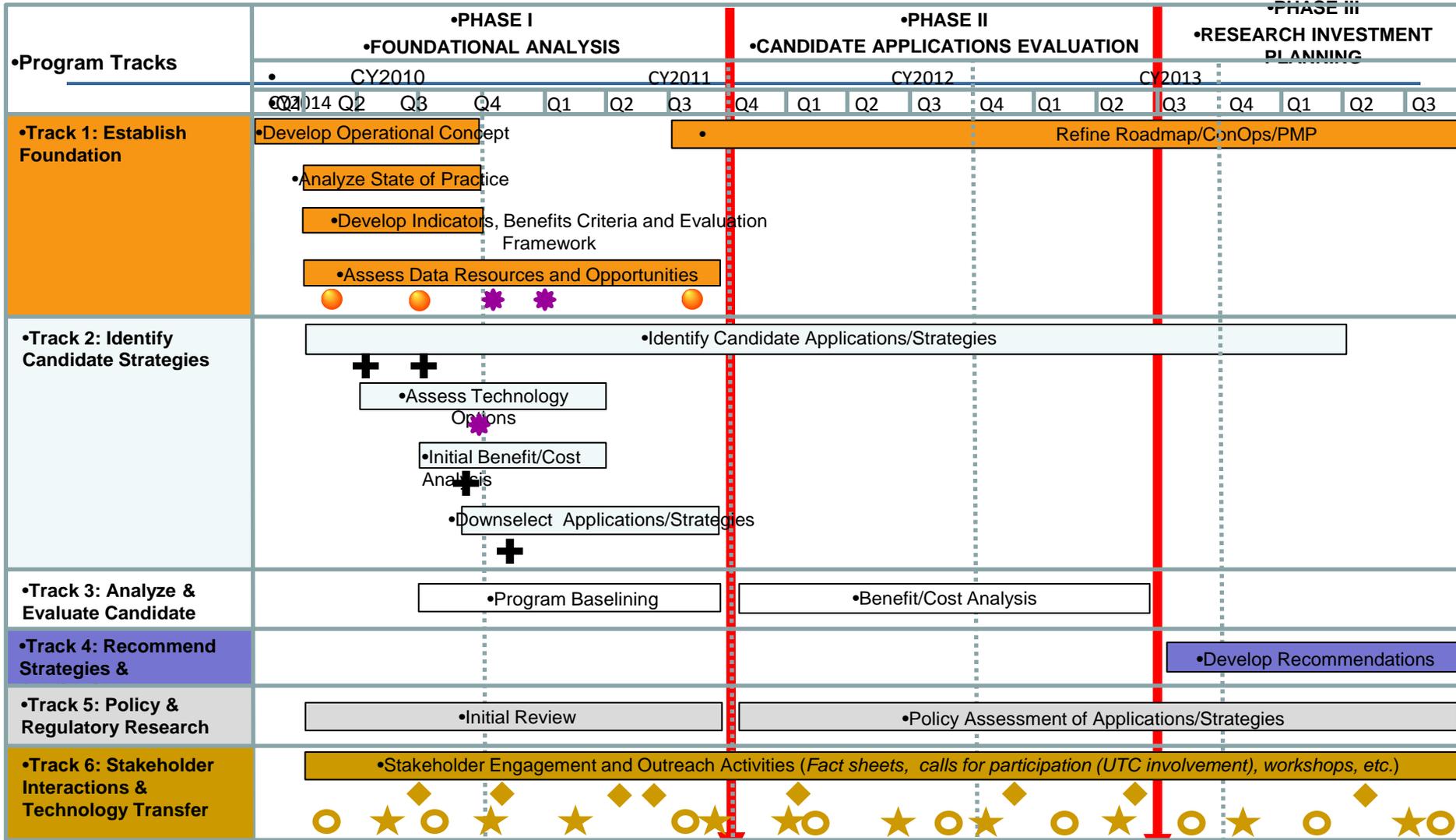
# AERIS Research Program: Six Tracks/Five Years (cont'd)

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- **Track 5: Develop the facts and evidence needed to inform any future policy and regulatory issues.**
  - Ideas include:
    - Exploration of the relationships between **traveler behavior** and **incentives** including **legislative/regulatory atmosphere** both within and outside the Department;
    - Monitor progress in **private sector application development**, commercialization, and markets;
    - Ongoing analysis of **carbon policies** and worldwide environmental agreements.
- **Track 6: Stakeholder Engagement and Tech Transfer**
  - Who do we engage?
  - How do we engage them?
  - How often do we engage them?
  - How do we do this effectively and creatively?



# •Applications for the Environment: Real-Time Information Synthesis (AERIS) High-Level Roadmap

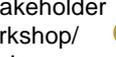
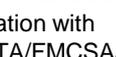


•Do the applications/strategies show enough environmental benefits to warrant further investment?

•Do the benefit/cost analyses indicate need for continued research?

•Are the stakeholders engaged?

•LEGEND

-  •Decision point
-  •Expert Panel Meeting
-  •Stakeholder workshop/review
-  •Outreach event
-  •Coordination with FHWA/FTA/FMCSA/NHTSA Research
-  •Coordination with Data Capture and Management and Dynamic Mobility Applications programs
-  •Resource from Data Management program



U.S. Department of Transportation  
**Research and Innovative Technology Administration**

# AERIS Stakeholder Engagement and Leveraging Research: Ideas? Input?

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- **New stakeholder group** for ITS JPO: **opportunities and challenges too.**
  - Some combination of environment experts and interest groups, IntelliDrive<sup>SM</sup> stakeholders, academic researchers, and other parties including private sector
    - **Leverage/support existing research and activities – how to best do this?**
    - **International interest** and cooperation is also critical
- Identification of **champions**, not just stakeholders – how to do this?
- **Challenge** with some stakeholders – how to overcome?
- **Creative strategies** for identifying and educating stakeholders and researchers about AERIS?
- How do we best **identify and engage stakeholders** and **leverage research** to help **accomplish AERIS research objectives** and help us **answer research questions?**
- **IDEAS/ANSWER NEEDED.**



# The “Don’t Knows”: Baseline Questions - A Starting Point

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- Existing benefits database: **environmental benefits**
  - Relatively **few evaluations** done, but older
    - Are results from a 10-year old study still valid today?
  - **Quality** of evaluations?
  - **Wide range of results/benefits** (too wide??)
- **New environmental data sources** from IntelliDrive<sup>SM</sup> – how is this a game-changer? Is it?
  - Improve ability to **refine, or redefine** what a “good” result is, narrow the benefit range – or change the result completely?
- How effective are our **environmental models**?
  - How can we make them better with IntelliDrive<sup>SM</sup>?



# The “Don’t Knows”: Overarching Evaluation Issues

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- In a **data-rich** IntelliDrive<sup>SM</sup> environment, what are the most state-of-the-art **techniques for modeling and evaluating** the performance of technologies that hope to show a **definitive and worthwhile environmental benefit**?
  - Some types of projects **cannot be evaluated** (on a large scale basis – can be modeled) here in the US (i.e., cordon pricing)
    - Differences in economics, pricing, social values make it difficult to **translate results across countries**, especially when the cost of fuel and taxation regimes vary so widely.
- Are there good techniques for **rolling local results up to national results**, and is the final product valid?
- What if **regulatory atmosphere** changes?
- How do modelers and evaluators account **for rapid changes in socio-economic factors**?
  - Do we need **better tools** to assess ITS and the environment under rapidly changing circumstances that can **dramatically affect the green choices** we do or do not make?
    - Relatively small changes in fuel costs or land use patterns can cause big changes in traveler or operator behavior



# The “Don’t Knows”: Basic (or Not So Basic) Questions on Data

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- What **environmentally-relevant data** can we get from cars, trucks and buses and other vehicles/modes?
- Does this **data support AERIS research objectives**?
  - If not, what do we need?
    - What are the **requirements** (granularity, frequency, type, mode, etc.)
  - Or, are the **data just not there** with the current sensor technology and post-processing ability we currently have?
  - To what extent can **post-processing improve the usefulness** of the current data set(s)?
- What types of data and how much are needed to make **improvements in current models and algorithms**? Would those improvements be significant?
- What is **the cost to capture and archive this data**, and is the benefit significant enough to warrant this expense?
- Data integration
  - How can in-vehicle data best be **integrated** with transportation system and other data (weather, etc.)
- If the industry could get its “dream data”, what would those data be?



# The “Don’t Knows”: What is a “Good Result” - Performance Measurement

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- When we look at possible applications, and read the literature associated with evaluations of those applications, **what does it mean** to have, for example, a new widget that could potentially save “300 million tons of carbon every year”.
  - **Is that good? Not so good?**
  - Good overall, or good for a particular application? Or particular location?
- By how much should any ITS **application or scenario be able to reduce GHG** to be a **viable candidate** for **future, more in-depth testing** and perhaps eventual deployment?
  - By individual vehicle, or local deployment, or nationally?
- What technologies and data are needed to differentiate, in an evaluation context, between **the improvements in air quality as opposed to GHG**?
  - Problem of **local benefit v. global benefit**.
- And the 800-lb gorilla in the room (**cue music of doom**):
  - Induced demand





# AERIS

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