MOTOR VEHICLE SPEED MANAGEMENT TECHNOLOGIES
TO IMPROVE SAFETY AND REDUCE FUEL CONSUMPTION AND GHG EMISSIONS

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Transportation Energy Committee (ACD70) & Alternative Transportation Fuels Committee (ACD80)
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Background

• Road Safety Vision 2010 Goal
  – 30% reduction in fatalities and serious injuries by 2010
  – Speed and intersection safety sub-target of 20% decrease in fatalities and serious injuries in speed- or intersection-related crashes

• 50 to 80% of traffic exceeds speed limits

• Speed is a factor in
  – 9 to 12% of all reported collisions
  – 20 to 30% of all fatal collisions

• Annual cost of speed related crashes: $2B (CCMTA, 2000)

• 10% reduction in speed (100 to 90 km/h) would reduce risk of injury by 20%, fatal injury by >30% (Sweden)

• Enforcing current speed limits would reduce hospital admissions by 15% and motor vehicle fatalities by 21% (Netherlands)
Background - 2

- Transportation represents the single largest source of Canada’s greenhouse gas emissions, about 26% of the total
- Travel speeds above 90 km/h reduce fuel efficiency and increase GHG emissions
- GHG reductions (Kyoto) (over 20 years)
  - Enforce 100 km/h speed limits  85 MT
  - Reduce speeds to 90 km/h  +77 MT
- Excessive speed variation impedes traffic flow, contributes to collisions and congestion
- Pollution affects public health
Objective

• To analyze and quantify the effects of technical and behavioural measures to maintain vehicle speeds in traffic in terms of their potential impact upon –
  – traffic speeds and congestion,
  – reductions in fuel consumption and greenhouse gases (GHG),
  – reductions in collisions and injuries, and
  – reductions in direct and social costs related to roadway incidents.
Key Issues

• Effectiveness of speed management technologies
  – Energy & GHG
  – Safety

• Driver behaviour - How and why do drivers make speed choices?

• Driver adaptation to speed control interventions and new technologies

• Fuel efficiency vs. speed of new technology vehicles

• Urban-rural differences
Project components

5-year $1.5M program:

1. Fleet tests of Intelligent Speed Adaptation (ISA)
2. Fleet tests of fuel consumption and cost displays
3. Driver attitudinal and behavioural studies
4. Models and simulation tools
5. Dynamometer tests to measure the relationship of speed vs. fuel consumption
Types of ISA

• Autonomous ISA
  – Works by combining vehicle location and map database technologies; map database contains speed limits
  – Critical issue of updating and maintaining speed limit data

• Dynamic (or Cooperative) ISA
  – Uses roadside beacons to communicate road speed information
  – Speed limit information updated dynamically
  – Speed limits can be varied in response to weather and traffic information, road blockages or work zones, collisions, and school zones
  – Potential for vehicle-vehicle communication
  – More expensive
Autonomous ISA

Digital map with speed limits

GPS receiver

Active Accelerator Pedal

Dynamic (Cooperative) ISA
Levels of Intervention

• Informative (Advisory) ISA:
  – Displays current speed limit (GPS + GIS)
  – Driver is informed when going above the speed limit (audible and/or visual warning)
  – Can be turned on/off voluntarily or can be mandatory.

• Supportive or Active ISA:
  – ISA increases upward pressure on the gas pedal
  – Can be overridden by pressing the gas pedal harder
  – Mandatory
Intelligent speed adaptation

• Key issues –
  – Is ISA practical in the Canadian environment?
  – What are the potential safety, efficiency and energy benefits?
Fuel cost / consumption display

• Key issue –
  – What are effects of on-board real-time fuel cost /consumption information display on driving behaviour?
  – Will they have an impact on vehicle purchase?

• Potential to link with insurance company programs that provide reductions in premiums based on driving habits
Driver attitudinal and behavioural studies

• Key issues –
  – Will ISA and real-time fuel cost information influence driver speed choice?
  – Will drivers accept ISA speed limitation?
  – What are drivers’ attitudes and behaviours with respect to these technologies?
Modelling

• Key issues –
  – Use of modelling and simulation tools to better understand the impact of speed management technologies on safety and emissions
  – Better quantify the relationship of increased speeds to poorer fuel consumption
  – Determine safety and GHG emissions at different levels of ISA penetration, road type, driver compliance and with different vehicle speeds, and a reduction in congestion resulting from a decrease in collisions
ISA Trials

• 1\textsuperscript{st} ISA trials in North America
• Two autonomous systems currently being evaluated in city of Ottawa
  – Imita system (Limit Advisor) with haptic feedback (increased pedal pressure)
  – Otto system with visual and audible warning
  – 20 vehicles (private, commercial, fleet)
Test Variables/Data Collection/Analyses

• Test Drivers
  – Male/female
  – 25-64 years old

• Data collection
  – Time, speed, location, PSL
  – Time, speed, mass air flow, coolant and inlet air temperature

• Data analyses
  – Speed profiles by posted speed limits (PSL)
  – Travel time
  – Energy use by PSL
  – Acceptance
  – Collisions
ISA Limit Advisor in Vehicle
Otto System

- Satellite
- GPS Satellite Constellation
- "Speed limit exceeded"
- "Red light camera"
- "Crosswalk"
- "Hazardous intersection"
- Maximum 80 km/h
Belonitor Trial

• Rewarding positive driving behaviour
• Determine effects on driving behaviour (speeding and following too closely) by rewarding drivers
• Vehicle
  – GPS for position and speed
  – Radar for following distance
  – Speed map
  – Display for feedback to the driver
• Central
  – Database for data analysis
  – Website for feedback to drivers
  – Website for speed map corrections
Belonitor Radar and Display
Future ISA Work

- Expanding autonomous ISA trial to include all of province of Ontario
- Possible trials in other Canadian cities
- Dynamic ISA
  - Feasibility study and trial next year

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