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CANADIAN REGULATIONS TO REDUCE GHG EMISSIONS FROM HEAVY-DUTY VEHICLES AND ASSOCIATED HYBRID VEHICLE TESTING

HDH informal working group

5th session

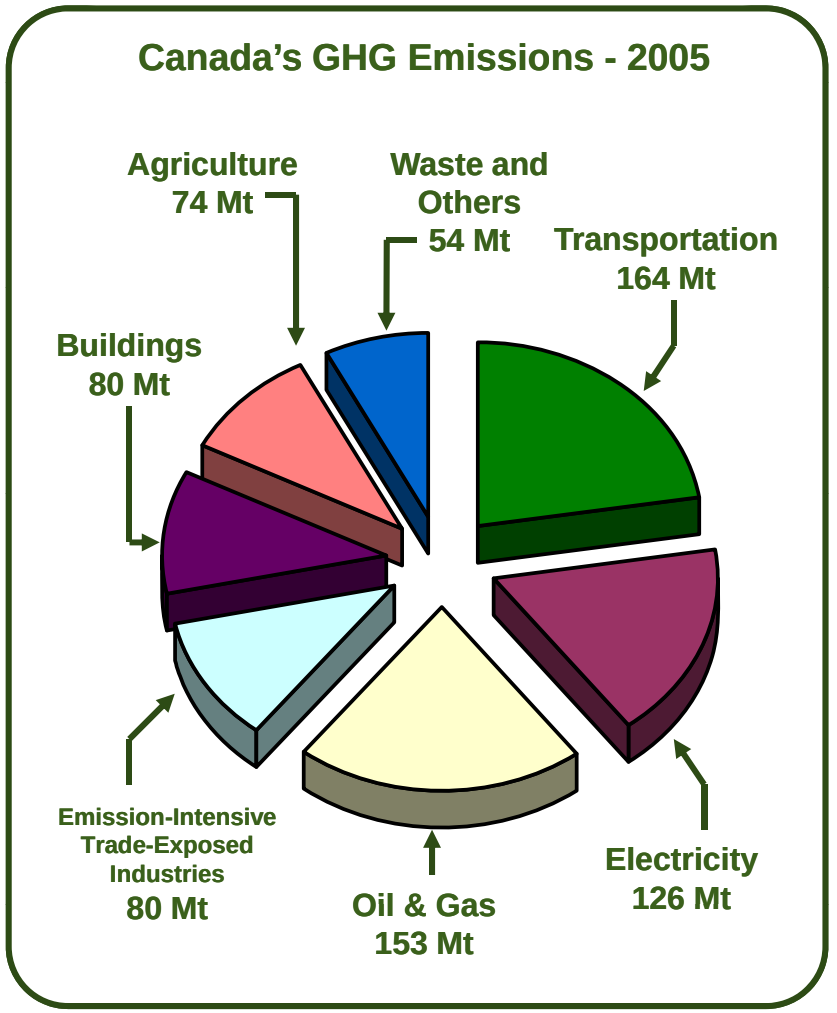
March 16-18, 2011, Ann Arbor, USA

HDH-05-xx

Working Paper N° HDH-05-11

Contribution of On-Road Heavy-Duty Vehicles to Climate Change

- Transportation is one of the largest sources of GHGs in Canada – 22% of total emissions in 2005
- On-road heavy-duty vehicles represent approximately 6% of total emissions in 2005
- Vehicle regulations are an important element of the Government's national approach to reduce air pollutants and GHG emissions to protect the health and environment of Canadians



Development of Canadian GHG Regulations for Heavy-Duty Vehicles

- On May 21, 2010, the Government of Canada announced that it will regulate greenhouse gas emissions (GHG) from on-road heavy-duty vehicles under the *Canadian Environmental Protection Act, 1999 (CEPA 1999)*

- The proposed regulations would establish GHG emission standards and test procedures for new on-road heavy-duty vehicles and engines of the 2014 and later model years, in alignment with the U.S.

- Environment Canada intends to publish proposed regulations in the *Canada Gazette,* Part I in mid-2011

Alignment of Canada-U.S. Standards

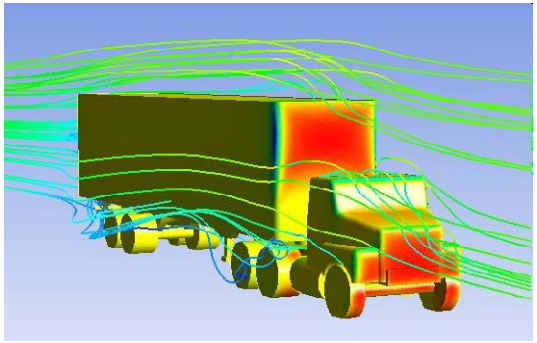
- Heavy-duty vehicle industry is well integrated across the two countries, both for the manufacturing and use

- Canada has a policy of alignment with U.S. standards for the transportation sector and has already implemented a number of regulations which are aligned with those of the U.S., including:
  - GHG emissions from on-road light-duty vehicles;
  - CAC emissions from on-road light-duty vehicles and heavy-duty vehicles and engines;
  - CAC emissions from off-road small spark-ignition engines;
  - CAC emissions from off-road compression-ignition engines; and
  - CAC emissions from marine engines and recreational vehicles.

Canada-U.S. Collaboration

- Emissions testing of heavy-duty vehicles at Environment Canada test facilities on a range of possible test cycles for regulatory development:
  - chassis dynamometer testing
  - assessment of power pack test procedures for hybrid vehicles

- Emissions analysis and testing related to heavy-duty vehicle aerodynamic performance



- Collaboration will continue as U.S. EPA and Environment Canada to address issues raised in respective regulatory processes and develop testing and compliance verification procedures

Working Towards Global Harmonization

- International harmonization of technical regulations for vehicles presents important opportunities
  - Promote the adoption of progressive standards for improved vehicle safety and environmental performance on a global scale
  - Facilitate international trade

- Environment Canada supports the development of new global technical emission regulations through its participation in the U.N. World Forum for Harmonization of Vehicle Regulations (Working Party 29)

- The development of heavy-duty vehicle greenhouse gas emission regulations is a priority for Canada and there is therefore an interest in the work under development by this working group

HD Hybrid Test Programs - Status

- Extensive experience with integration and optimization of hybrid systems for emissions and fuel economy with past partners including:
  - General Electric
  - BAE Systems
  - Allison
  - Azure Dynamics
  - NYCT
  - SEPTA
  - STM
  - Translink
  - Orion – Daimler
  - New Flyer
  - Nova

HD Hybrid Test Programs – Status cont'd

- Two test series have been completed in support of GHG emission regulation development
  - A to B chassis testing for vehicles
  - Hybrid and Conventional
    - *Utility*
    - *Delivery*

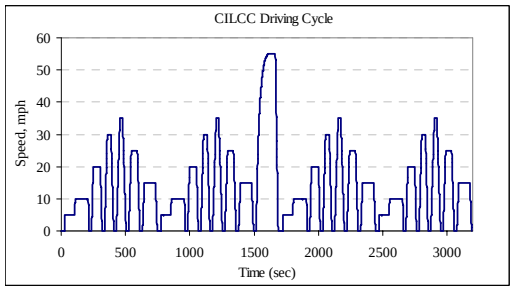
- Assessment of power pack test procedures is planned for March/April 2011

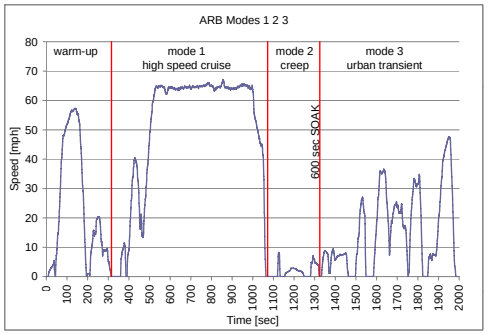
HD Hybrid Test Programs - Goals

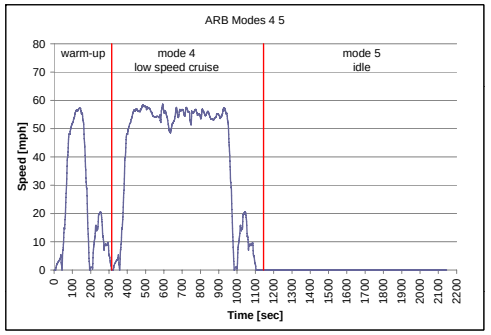
- Goals include:
  - investigation of test procedures and drive cycles
  - quantification of greenhouse gas reductions with the use of heavy-duty hybrid technology
  - characterization of typical CO_2 emission rates
  - quantification of test to test variability
  - determination of the impacts of PTO and auxiliary loads
  - assessment of the adequacy of tolerances for target vs. actual trace speeds during chassis dynamometer testing
  - evaluation of cold climate impacts on fuel consumption and pollutant emission rates

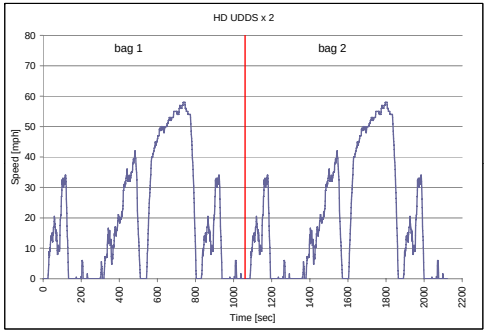
Drive Cycles Investigated

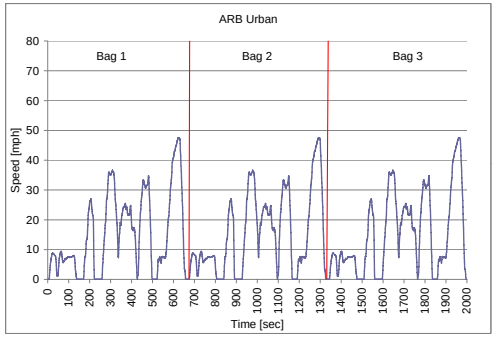
- Challenges
  - SOC balancing
  - Realistic cycles for different vocational trucks
  - DPF regeneration

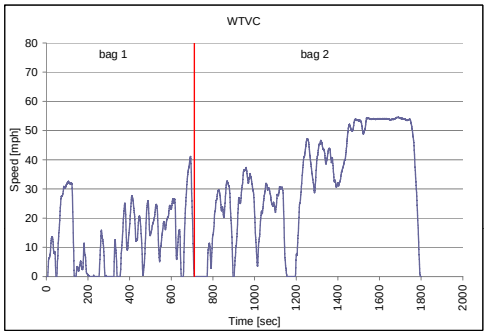


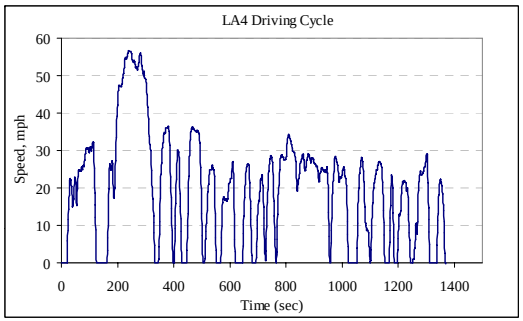












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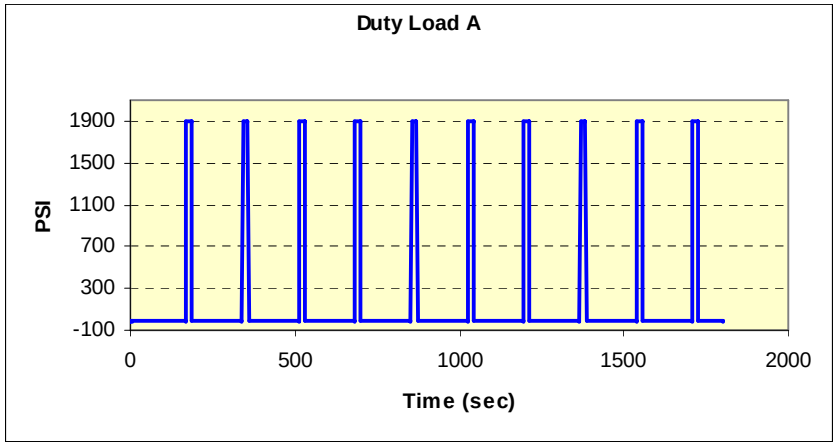
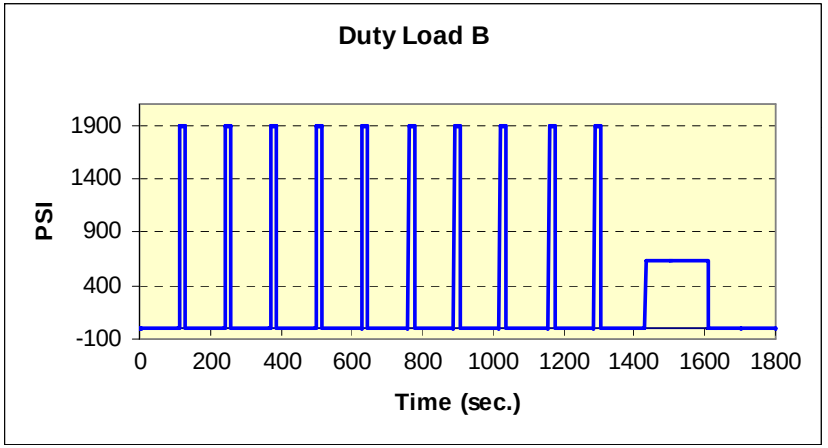
PTO Cycles

- Utility trucks were tested using two PTO duty cycles for the hydraulic lift arm
  - PTO test rig was not used at the time; this had a negative influence on repeatability and ability to follow the trace





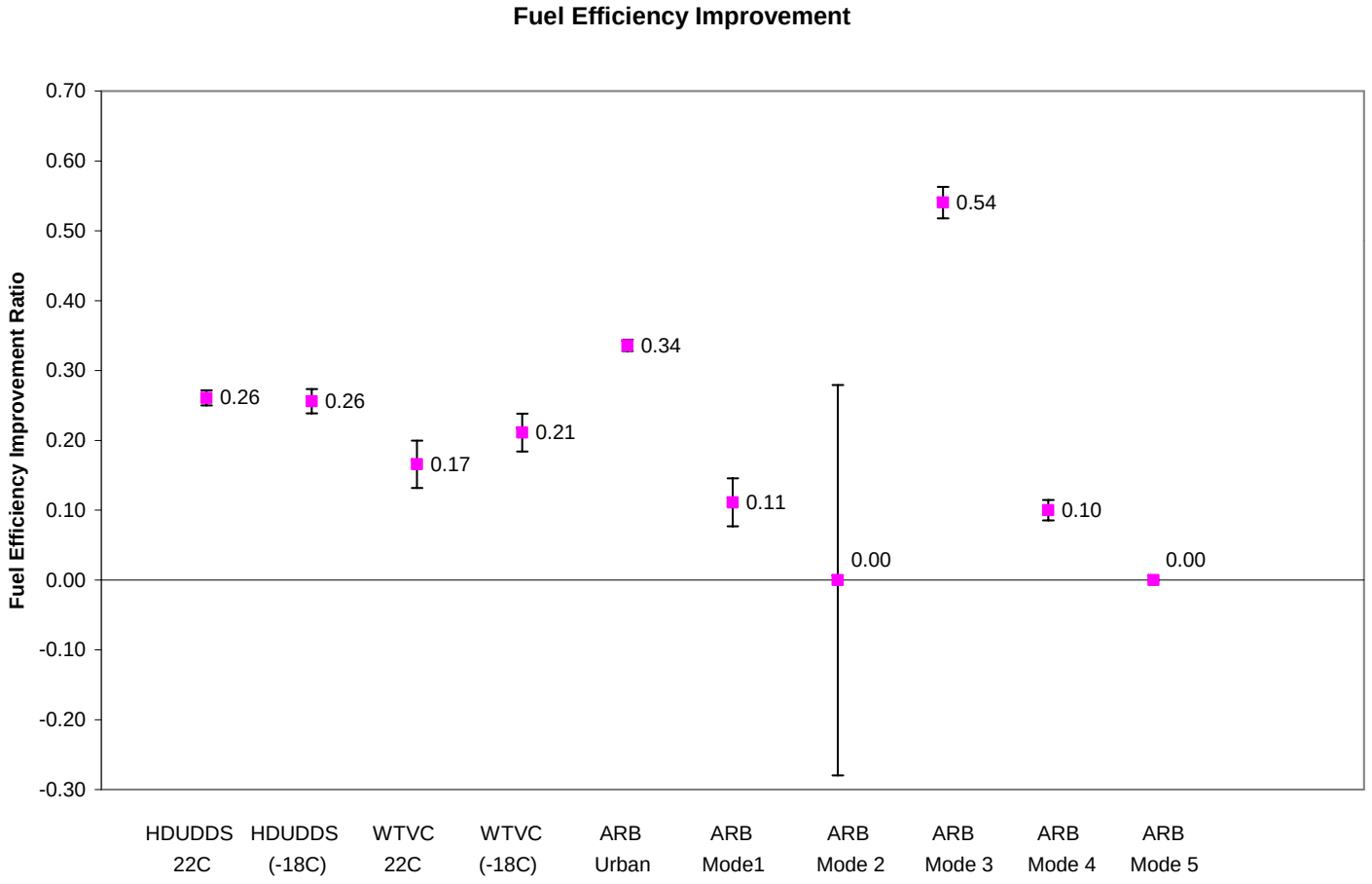
Emissions Measurement

- Parameters recorded continuously
  - Vehicle speed
  - Emissions: CO_2, CO, NO_x, THC
  - Fuel consumption by carbon balance
  - J1939 parameters (incl. SOC)
  - HEV battery current and voltage (Hioki 3193)

- GHGs: CO_2, N_2O, CH_4

- Regulated Emissions: CO, NO_x, THC, PM

Delivery Truck Fuel Efficiency Improvement



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Utility Truck Fuel Efficiency Improvement