MOVES2009 Update

OTC Meeting
September 3, 2009

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MOVES

- **MOtor Vehicle Emission Simulator**
- **State-of-the-art modeling framework**
- **Will replace current models (MOBILE & NONROAD) and expand capabilities**
- **Designed to allow easier incorporation of large amounts of in-use data from a variety of sources**
  - MOBILE structure limited ability to incorporate new emissions data

Why is EPA developing MOVES?

- **CAA requires EPA to regularly update emission factors and emission factor models**

- **FORTRAN code used in MOBILE6.2 is obsolete and increasingly difficult to maintain**

- **Modular database structure more modern, easier to update with new emissions, fleet and activity data**

- **MOVES will eventually incorporate functions of the current NONROAD model, providing a single, comprehensive modeling system**

MOVES Uses New Data

✓ **Activity**

– In-use vehicle trip patterns

– Rural area activity data

✓ **Light-duty vehicles**

– Assessed millions of light-duty vehicles

– Landmark gasoline PM study (Kansas City)

– Remote Sensing Data

✓ **Heavy-duty vehicles**

– More than 100 in-use vehicles from WVU

– New on-board real-world driving data from over 300 vehicles

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# New Factors Affect Emissions in MOVES

- PM temperature effects
- PM speed effects
- Heavy duty deterioration effects
- Extended idle emissions
- Permeation emissions

Early Draft MOVES Results

- **Data collected since MOBILE6 released drives differences between MOVES and MOBILE6**
- **National trends**
  - HC and CO emissions similar or lower than MOBILE6.2
  - Total NOx emissions higher than MOBILE6.2
  - Total PM emissions substantially higher than MOBILE6.2
- **Local results may vary**
  - Local fleet mix, fuels, activity are important
  - Temperature drives PM emissions
- **For attainment analysis, relative change in emissions between base year and attainment year is more important than absolute emissions**

NO$_x$

- I/M program data shows MOBILE6 underestimated NOx emissions from light trucks

- On-road data on heavy trucks shows higher emissions than MOBILE6 estimated from cert data

- Extended idle emissions become significant share of heavy-duty inventory in future

City B - NOx

City A - NOx

City C - NOx
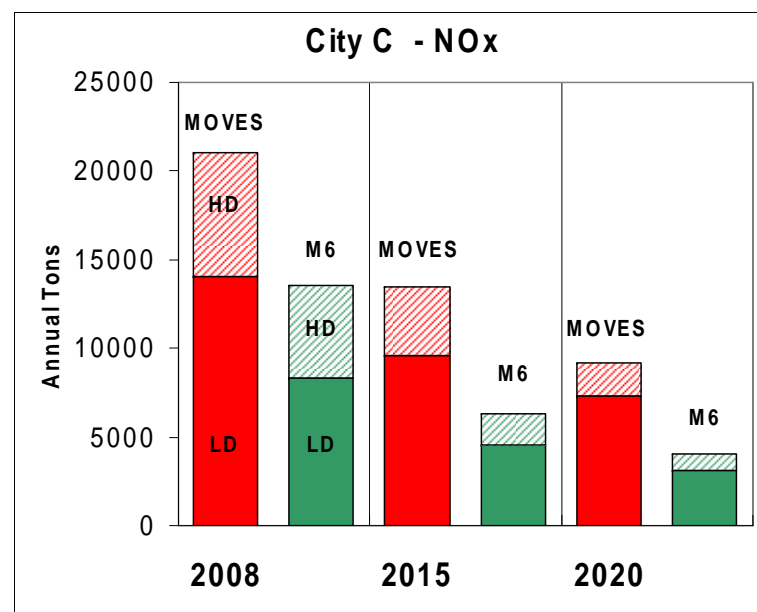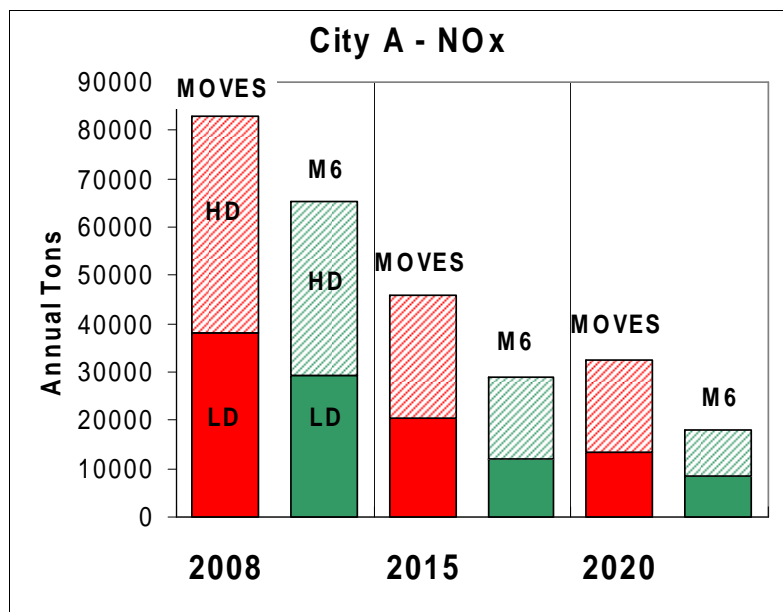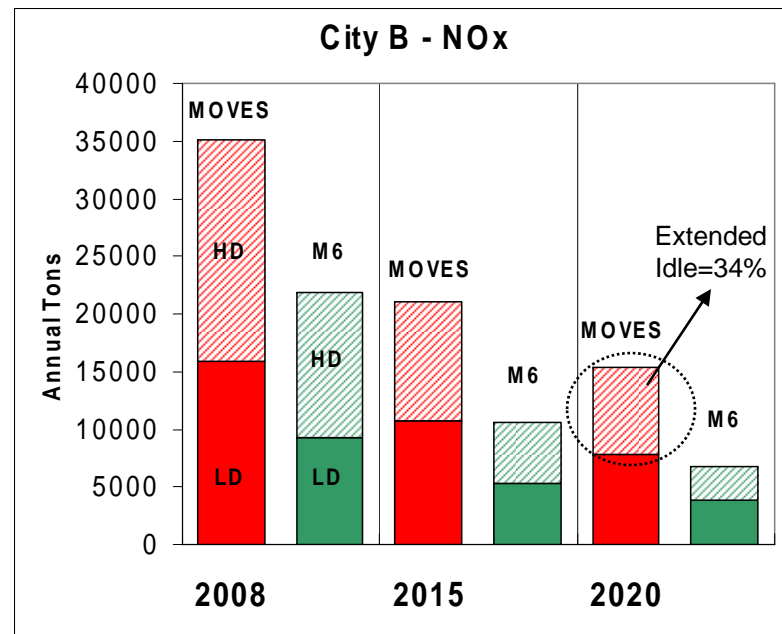
HC

- I/M program data shows MOBILE6 overestimated HC emissions from newer technology cars

- Evaporative emissions on newer technology vehicles very low; re-evaluating leak emissions for final model

City A - HC

City B - HC

City C - HC
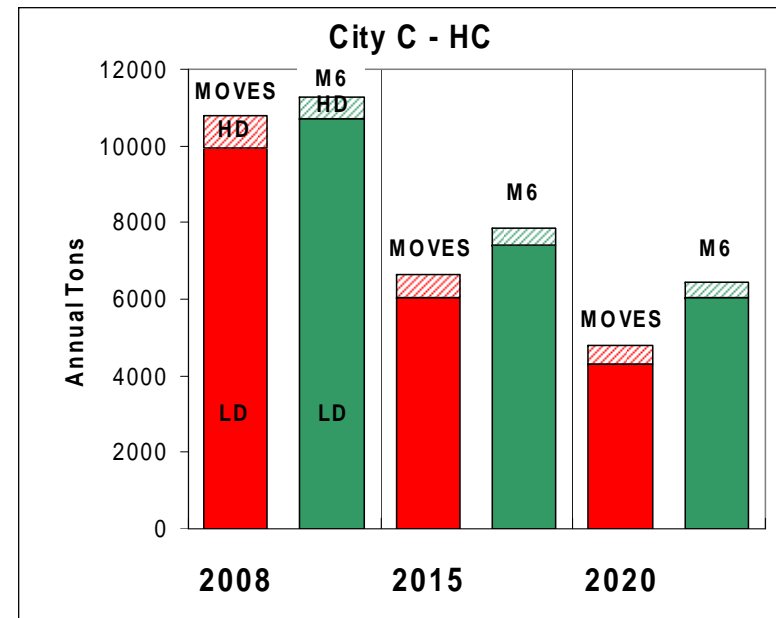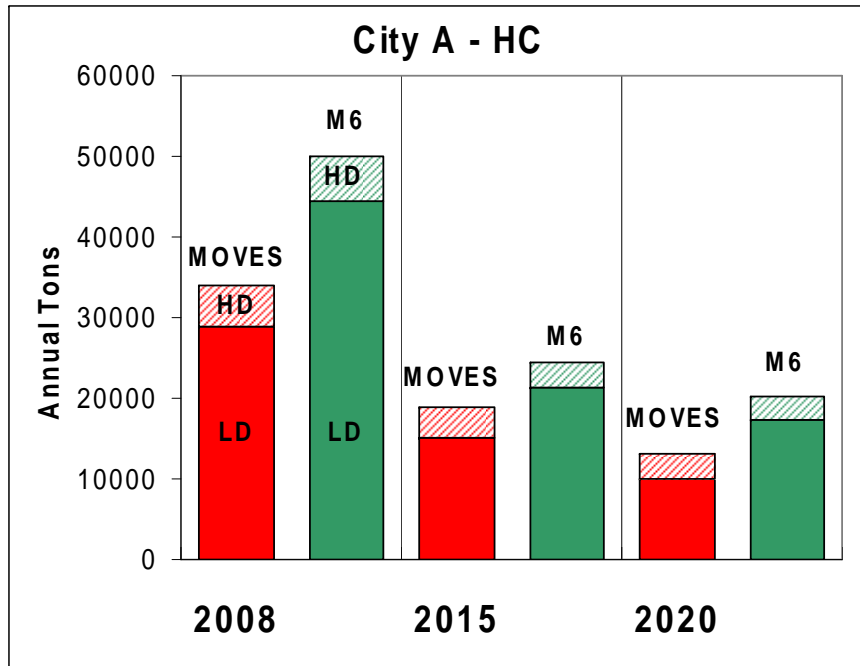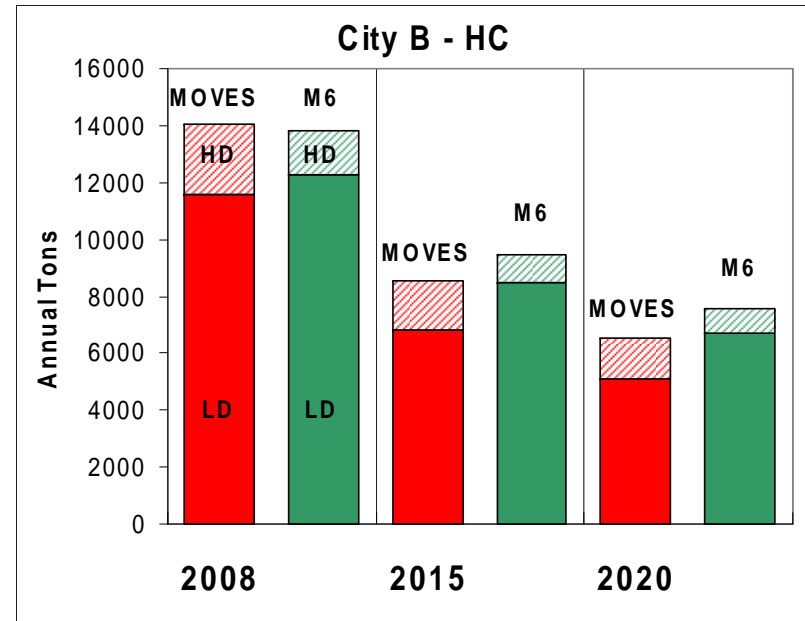
PM$_{2.5}$

- Kansas City program found high gas PM emissions esp. at cold temps
- New data on heavy trucks shows higher deterioration than MOBILE6
- MOVES accounts for impact of vehicle speed – MOBILE did not

City B - PM2.5

City A - PM2.5

City C - PM2.5
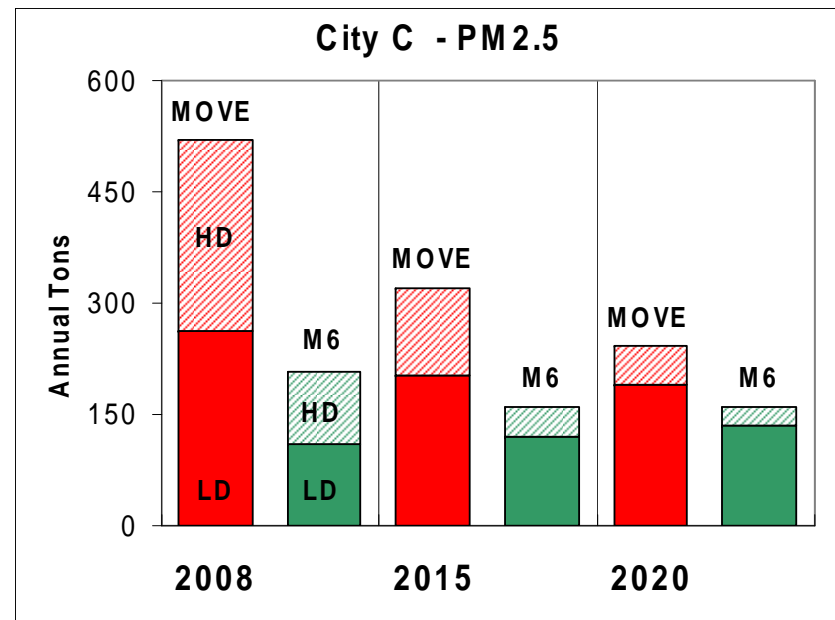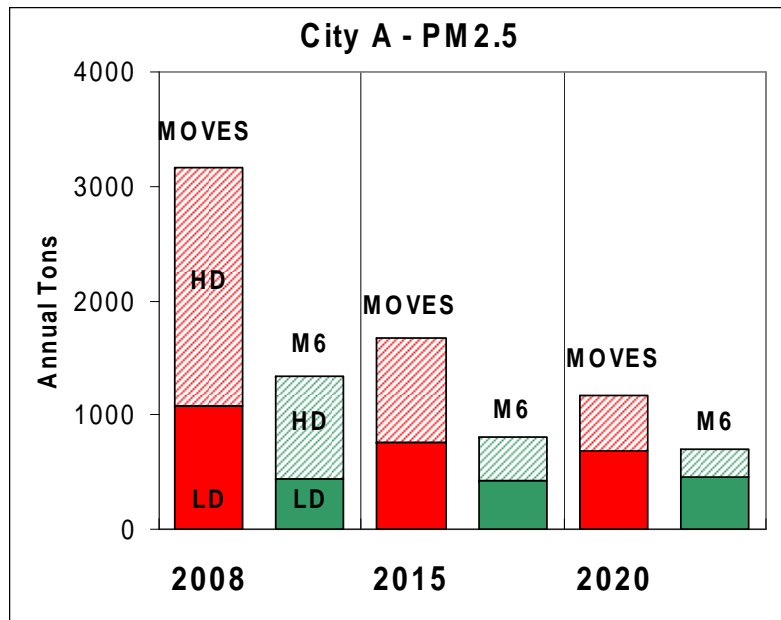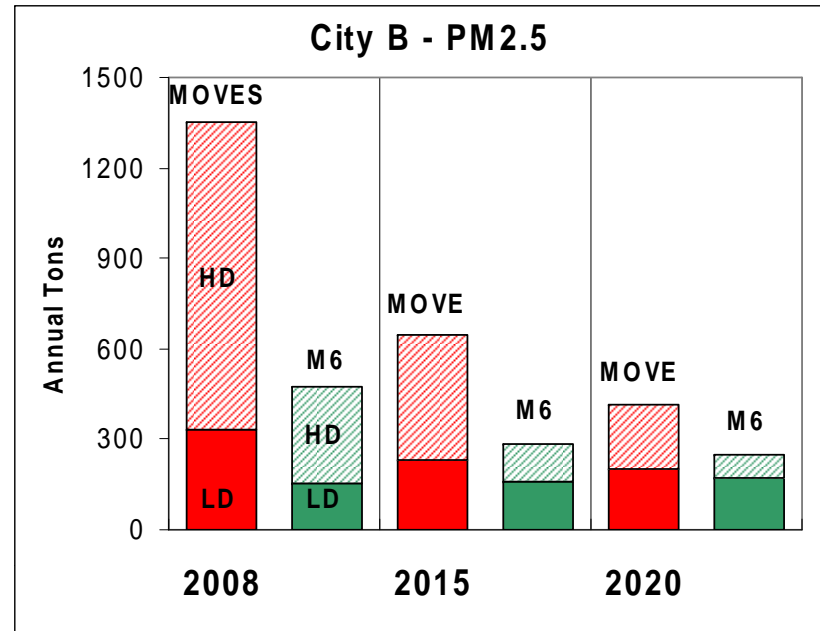
Percent Reduction in On-Road Emissions 2008 to 2015

	City A		City B		City C	
	MOVES	MOBILE6	MOVES	MOBILE6	MOVES	MOBILE6
HC	50%	50%	39%	32%	38%	31%
NOx	54%	56%	40%	52%	36%	53%
PM2.5	57%	40%	52%	40%	38%	23%

What It Means

- **Higher NOx and PM emissions mean mobile sources have bigger role in attainment**
- **Percent reduction from base year is key to attainment analysis**
  - PM2.5 shows higher overall emissions and higher % reductions
    - Effect on attainment demonstrations could be positive
  - NOx shows higher overall emissions but lower % reduction
    - Harder to show attainment
    - Future NOx control measures will have a bigger impact
- **States may need to redo some motor vehicle emissions budgets to meet conformity requirements with MOVES**

Making the Transition to MOVES

MOVES Schedule

- **January 2005**
  - MOVES2004 released
    - Includes energy consumption, greenhouse gases
- **May 2007**
  - MOVES Demo released
    - Basic structure of MOVES without criteria pollutant emission factors
- **April 2009**
  - Release of Draft MOVES2009
    - Adds draft criteria pollutant emission factors
- **End of 2009**
  - Planned release of official MOVES2009
    - Final onroad criteria pollutant model
- **2010**
  - Begin adding nonroad emissions to MOVES

MOVES

Draft MOVES2009 - Limitations

- **Draft model**
  - **No official use requiring Draft MOVES2009**
  - **Cannot be used for SIPs or conformity analyses**
- **Does not include all data or features planned for official MOVES2009 and has known and unknown bugs, for example:**
  - Motorcycle emissions not yet included
  - Plan to add more flexibility for VMT input
  - Known bugs in refueling vapor and spillage processes and project level scale

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Why Release Draft MOVES2009?

- **Help us identify problems with MOVES**
- **Provide feedback on whether MOVES meets user needs**
  - What we can do to improve it?
- **Identify guidance issues**
- **Start learning MOVES now to be ready to use final MOVES2009 as soon as it is released**
  - Use MOVES2009 for SIPs due in 2012 and 2013

Official MOVES2009

- **Official MOVES2009 planned for release at the end of 2009**

- **Will be official version of MOVES for on-road vehicles outside of California**

- **Use will be required for:**
  - **State Implementation Plans (SIPs)**
  - **Transportation Conformity Analysis**

Where Are We Now?

- **Processing comments**
  - Received over 400 total comments from 44 individuals or organizations (plus about 150 internal comments based on our own testing and review of MOVES)
  - Comments include bug reports, feature requests, guidance issues, and general questions
  - Cannot respond to each individual commenter immediately, but we are reviewing every comment we receive

- **Model improvements**
  - Fixing bugs and adding some new features to MOVES
    - Can't make all changes users have asked for, but will try to address the most important ones

Where Are We Now?

- **Developing additional input and output options and data converters**
  - Adding daily VMT input to County Data Manager
  - Adding more activity input options to Project Data Manager
  - Adding additional lookup table output options
  - Developing post-processor for SMOKE
  - Creating more MOBILE to MOVES data converters
- **Training**
  - Together with FHWA, will have given over 20 hands-on training sessions by mid-October (20-50 participants at each class
  - Working on web-based training on specialized topics such as running MOVES in batch mode operation and setting up a distributive network
  - Early stages of planning additional hands-on training after final release of MOVES2009

Where Are We Now?

- **Writing guidance**
  - Developing three guidance documents
    - Technical Guidance
      - Default vs. local inputs
      - Similar to MOBILE6.2 Technical Guidance
    - Project Level Guidance
      - Using MOVES for quantitative PM hotspot analysis
      - Using air quality dispersion models for quantitative PM hotspot analysis
    - SIP and Conformity Policy Guidance
      - When will MOVES be required for SIPs?
      - What is the grace period for MOVES for transportation conformity
  - Will share drafts of all three for comment before we finalize them

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Next Steps

What Should You Do Now?

- **Update computer hardware**
  - **Dual-core processor (faster is better)**
  - **At least 1 GB memory (more is better)**
  - **At least 40 GB storage (more is better, output files can be very large)**
  - **Consider setting up a distributive network (specs of "master" computer are key)**
  - **Windows XP or 32-bit Vista**
    - **Current version of MySQL does not work on 64-bit Vista**

What Should You Do Now?

- **Build staff expertise in relational databases and MYSQL**
  - Not needed for simple runs
  - Some basic knowledge gives users flexibility to customize outputs and view inputs
  - In-house expert would be helpful for more advanced analysis
- **Subscribe to MOBILENEWS email list for MOVES updates**

 **http://www.epa.gov/otaq/models/mobilelist.htm**

Feedback

- **We need your comments and ideas**
  - Does MOVES meet your needs?
  - Did you find errors in MOVES?
- **Official Comment Period:**
  - Began when Draft MOVES2009 was released
  - Still taking comments, but there are limits on what changes we can incorporate in final version at this late date
- **We are interested in your ideas to make MOVES better meet your needs**
- **Best way to provide comments:**
  - Send an email to: mobile@epa.gov

Visit the MOVES website:
http://www.epa.gov/otaq/ngm.htm
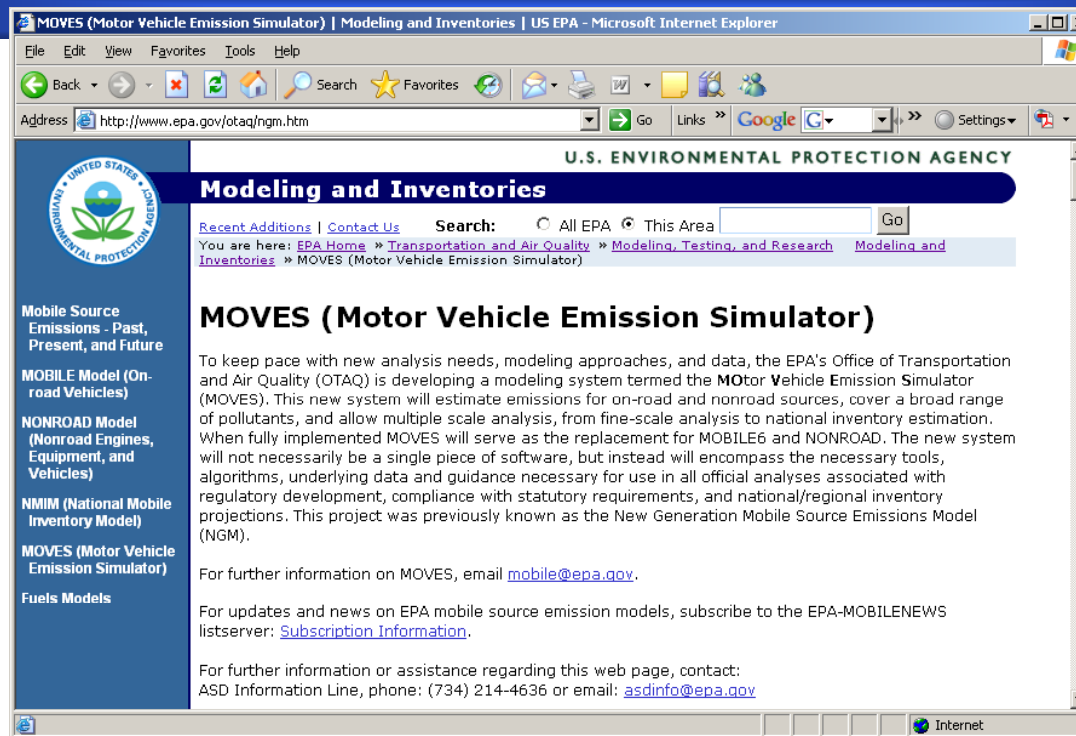
- Software, technical documentation, conference and meeting presentations, and other helpful background materials