Day 4 Agenda
(Advanced Course – Day 2)

- Detailed discussion of database output
  - Commands
  - Aggregating results
- Working with model year output – vehicle lifetime emissions estimates
- Control measure analysis
  - Measures analyzed directly with MOBILE6
  - "Off-Model" emissions estimates

VIII. DETAILED DISCUSSION OF DATABASE OUTPUT

Database Output Options in MOBILE6

- Database output format allows the user to specify very detailed output (most similar output in MOBILE5 was the by-model-year output)
- However, unless variables in the output file are limited, each run will comprise approximately 40 megabytes per scenario
- Details of specific database output formats are summarized on the following pages

Database Output

- Requested with the DATABASE OUTPUT command
- All DATABASE commands are placed in the Header section of the input file
- Default file name extension is *.TB1
- The output file is a single table stored in tab-separated ASCII format
- Column headers are added with the WITH FIELDNAMES command

Three Formats of Database Output

- Hourly output
  - Default format
  - Most detailed output
  - Maximum number of lines in this file is 295,800

- Daily output
  - Specified with the DAILY OUTPUT command
  - Maximum number of lines in this file is 12,325

- Aggregated output
  - Specified with the AGGREGATED OUTPUT command
  - The maximum number of lines in this file is 84 (28 vehicle classes × 3 pollutants)

Sample MOBILE6 Database Output File
(DAILY OUTPUT Specified)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	FILE	RUN	SCEN	POL	VTYPE	ETYPE	FTYPE	AGE	GM_MILE	GM_DAY	STARTS	ENDS	MILES	MPG	FACVMT	REGDIST	VCOUNT	MYR
2	1	1	1	1	1	1	1	7	0.234	6.783	7.28	5.38	29.04	22.64	0.3421	0.0831	110.8046	1995
3	1	1	1	1	1	1	2	7	0.208	6.043	7.28	5.38	29.04	22.64	0.4978	0.0831	110.8046	1995
4	1	1	1	1	1	1	3	7	0.289	8.378	7.28	5.38	29.04	22.64	0.1305	0.0831	110.8046	1995
5	1	1	1	1	1	1	4	7	0.335	9.719	7.28	5.38	29.04	22.64	0.0297	0.0831	110.8046	1995
6	1	1	1	1	1	2	5	7	0.179	5.195	7.28	5.38	29.04	22.64	1	0.0831	110.8046	1995
7	1	1	1	1	1	5	5	7	0.092	2.664	7.28	5.38	29.04	22.64	1	0.0831	110.8046	1995
8	1	1	1	1	1	8	5	7	0.035	1.028	7.28	5.38	29.04	22.64	1	0.0831	110.8046	1995
9	1	1	1	1	1	3	5	7	0.090	2.622	7.28	5.38	29.04	22.64	1	0.0831	110.8046	1995
10	1	1	1	1	1	4	5	7	0.020	0.583	7.28	5.38	29.04	22.64	1	0.0831	110.8046	1995
11	1	1	1	1	1	7	5	7	0.010	0.299	7.28	5.38	29.04	22.64	1	0.0831	110.8046	1995
12	1	1	1	1	1	6	1	7	0.225	6.523	7.28	5.38	29.04	22.64	0.3421	0.0831	110.8046	1995
13	1	1	1	1	1	6	2	7	0.266	7.713	7.28	5.38	29.04	22.64	0.4978	0.0831	110.8046	1995
14	1	1	1	1	1	6	3	7	0.643	18.67	7.28	5.38	29.04	22.64	0.1305	0.0831	110.8046	1995
15	1	1	1	1	1	6	4	7	0.234	6.802	7.28	5.38	29.04	22.64	0.0297	0.0831	110.8046	1995
16	1	1	1	1	2	1	1	7	0.235	8.158	8.06	5.75	34.73	16.87	0.3421	0.0731	14.4963	1995
17	1	1	1	1	2	1	2	7	0.214	7.426	8.06	5.75	34.73	16.87	0.4978	0.0731	14.4963	1995
18	1	1	1	1	2	1	3	7	0.300	10.419	8.06	5.75	34.73	16.87	0.1305	0.0731	14.4963	1995
19	1	1	1	1	2	1	4	7	0.343	11.908	8.06	5.75	34.73	16.87	0.0297	0.0731	14.4963	1995
20	1	1	1	1	2	2	5	7	0.183	6.346	8.06	5.75	34.73	16.87	1	0.0731	14.4963	1995
21	1	1	1	1	2	5	5	7	0.077	2.664	8.06	5.75	34.73	16.87	1	0.0731	14.4963	1995
22	1	1	1	1	2	8	5	7	0.048	1.65	8.06	5.75	34.73	16.87	1	0.0731	14.4963	1995
23	1	1	1	1	2	3	5	7	0.071	2.463	8.06	5.75	34.73	16.87	1	0.0731	14.4963	1995
24	1	1	1	1	2	4	5	7	0.017	0.583	8.06	5.75	34.73	16.87	1	0.0731	14.4963	1995
25	1	1	1	1	2	7	5	7	0.014	0.499	8.06	5.75	34.73	16.87	1	0.0731	14.4963	1995
26	1	1	1	1	2	6	1	7	0.225	7.82	8.06	5.75	34.73	16.87	0.3421	0.0731	14.4963	1995
27	1	1	1	1	2	6	2	7	0.251	8.723	8.06	5.75	34.73	16.87	0.4978	0.0731	14.4963	1995
28	1	1	1	1	2	6	3	7	0.646	22.445	8.06	5.75	34.73	16.87	0.1305	0.0731	14.4963	1995
29	1	1	1	1	2	6	4	7	0.216	7.515	8.06	5.75	34.73	16.87	0.0297	0.0731	14.4963	1995
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Three Types of Database Fields

- Key Fields – Used to identify records

- Echoed Fields – Provided to facilitate conversion of emisson factor results into alternate units (e.g., grams per gallon, etc.)

- Calculated Fields – Results that have been calculated by the model

Key Fields

- FILE, RUN, SCEN – identify the file number, run number, and scenario number

- VTYPE – identifies the vehicle type (ranges from 1 to 28)

- POL – identifies pollutant:

  1 = HC
  2 = CO
  3 = NOx

- AGE – identifies vehicle age (ranges from 0 to 24)

- ETYPE – identifies emission type:

  1 = Exhaust running emissions (+ start emissions from HDVs)
  2 = Exhaust start emissions from LDVs
  3 = Evaporative hot soak emissions
  4 = Evaporative diurnal emissions
  5 = Evaporative resting loss emissions
  6 = Evaporative running loss emissions
  7 = Crankcase emissions
  8 = Evaporative refueling emissions

Key Fields (Continued)

- FTYPE – identifies facility type:

  1 = Freeway
  2 = Arterial
  3 = Local
  4 = Freeway Ramp
  5 = None (e.g., for starts or diurnals)

- HOUR – identifies the hour of the day (ranges from 1 to 24; recall that 1 = 6:00 a.m. to 6:59 a.m.)

Echoed Fields

- STARTS – reports the number of starts per day (daily output) or starts per hour (hourly output)
- ENDS – reports the number of trip ends per day (daily output) or trip ends per hour (hourly output) that result in a hot soak
- MILES – reports the number of miles per day (daily output) or miles per hour (hourly output)
- MPG – reports the fuel economy (miles per gallon)
- HRVMT – reports the fraction of VMT occurring during each hour
- FACVMT – reports the fraction of VMT occurring on each facility
- REGDIST – reports the registration distribution (function of vehicle type and vehicle age)

Echoed Fields (Continued)

- VCOUNT – reports the **national** vehicle count for each vehicle type (in millions)
- AMBTEMP – reports the ambient temperature by hour (°F)
- DIURTEMP – reports the temperature by hour used in the diurnal calculations (°F)
- MYR – reports the vehicle model year
- VMT – reports the VMT fraction (or VMT mix) for each vehicle type (Aggregated output)
- CAL_YEAR – reports the calendar year

Calculated Fields

- GM_DAY – grams per day (daily output)
- GM_HR – grams per hour (hourly output)
- GM_MI – grams per mile
- Note:

  GM_MI = GM_DAY ÷ MILES

  GM_MI = GM_HR ÷ MILES

- Other Units:

  Grams/Start = GM_DAY ÷ STARTS

  Grams/Gallon = GM_DAY * MPG ÷ MILES

Summary of DATABASE Output Fields

Field Type	Output Field	Output Format		
		Hourly	Daily	Aggregate
Key	FILE/RUN/SCEN	X	X	X
	POL	X	X	X
	VTYPE	X	X	X
	ETYPE	X	X	--
	FTYPE	X	X	--
	AGE	X	X	--
	HOUR	X	--	--
Echoed	STARTS	X	X	X
	ENDS	X	X	X
	MILES	X	X	X
	MPG	X	X	X
	HRVMT	X	--	--
	FACVMT	X	X	--
	REGDIST	X	X	--
	VCOUNT	X	X	--
	AMBTEMP	X	--	--
	DIURTEMP	X	--	--
	MYR	X	X	--
	VMT	--	--	X
	CAL_YEAR	--	--	X
Calc'd	GM_HR	X	--	--
	GM_DAY	--	X	X
	GM_MI	X	X	X

Aggregating DATABASE Output (AGGREGATED OUTPUT)

- The most aggregated form of DATABASE output is when the command "AGGREGATED OUTPUT" is specified

- This is very similar to descriptive output, except that all 28 vehicle classes are included in the output file (unless specified otherwise)

- In addition, an overall fleet-average emission rate is not included in this (or any) DATABASE output format

- However, the fleet-average emission rate can be calculated by applying the appropriate weighting factors (i.e., the "VMT" field)

- BE CAREFUL...

  - Specifying roadway type will not impact results from AGGREGATED OUTPUT (all are included in the reported emission values)

  - Specifying emission type (DATABASE EMISSIONS) will impact emission values

Sample DATABASE Output Using the AGGREGATED OUTPUT Command

	FILE	RUN	SCEN	CAL_YEAR	POL	VTYPE	GM_MILE	GM_DAY	STARTS	ENDS	MILES	MPG	VMT
2	1	1	1	2000	1	1	2.2904	67.511	0.0769	0.0569	29.4755	22.61	0.494114
3	1	1	1	2000	1	2	2.4082	84.989	0.2971	0.2122	35.2916	16.91	0.065396
4	1	1	1	2000	1	3	2.4533	86.582	0.2971	0.2122	35.2916	16.91	0.217702
5	1	1	1	2000	1	4	3.6829	125.502	0.6209	0.4433	34.0771	16.5	0.066258
6	1	1	1	2000	1	5	3.7108	126.452	0.6209	0.4433	34.0771	16.5	0.03047
7	1	1	1	2000	1	6	2.8643	102.046	0.4563	0.3258	35.6267	10.34	0.028452
8	1	1	1	2000	1	7	5.086	157.205	0.9809	0.7004	30.9094	10.17	0.001015
9	1	1	1	2000	1	8	7.9752	159.605	1.2412	0.8862	20.0126	10.02	0.000592
10	1	1	1	2000	1	9	4.6834	126.779	0.7628	0.5446	27.0698	10.26	0.001186
11	1	1	1	2000	1	10	5.0613	133.602	1.0336	0.738	26.3966	10.23	0.00255
12	1	1	1	2000	1	11	7.4078	166.318	1.7181	1.2267	22.4517	10.06	0.001229
13	1	1	1	2000	1	12	8.158	171.733	2.0367	1.4542	21.0507	10.01	0.000005
14	1	1	1	2000	1	13	0	0	0	0	0	0	0
15	1	1	1	2000	1	14	0.7935	15.44	0.2988	0.2134	19.4586	0	0.001166
16	1	1	1	2000	1	15	2.6205	28.181	1.7458	1.2465	10.7539	0	0.00028
17	1	1	1	2000	1	16	0.2974	13.506	0	0	45.4056	0	0.009513
18	1	1	1	2000	1	17	0.3406	16.851	0.0006	0.0004	49.4674	0	0.002789
19	1	1	1	2000	1	18	0.3851	23.951	0.0259	0.0185	62.2014	0	0.00227
20	1	1	1	2000	1	19	0.3826	24.941	0.008	0.0057	65.185	0	0.000977
21	1	1	1	2000	1	20	0.5826	37.895	0.0553	0.0395	65.0443	0	0.005671
22	1	1	1	2000	1	21	0.7385	45.541	0.1144	0.0817	61.6706	0	0.008572
23	1	1	1	2000	1	22	0.8257	89.992	0.5482	0.3914	108.9881	0	0.010823
24	1	1	1	2000	1	23	1.0467	175.949	0.5514	0.3937	168.0957	0	0.038601
25	1	1	1	2000	1	24	2.5372	25.424	0	0	10.0204	0	0.006229
26	1	1	1	2000	1	25	10.9871	299.18	1.7675	1.262	27.2301	9.42	0.000597
27	1	1	1	2000	1	26	1.1166	109.058	0.0789	0.0563	97.6678	0	0.000921
28	1	1	1	2000	1	27	0.8317	22.647	0.0068	0.0048	27.2301	0	0.001305
29	1	1	1	2000	1	28	0.653	28.644	0	0	43.8645	0	0.001315
30	1	1	1	2000	2	1	18.3333	540.382	0.0769	0.0569	29.4755	22.61	0.494114

Example 15

Using the DATABASE OUTPUT and AGGREGATED OUTPUT commands, generate fleet-average VOC, CO, and NOx emission rates for calendar year 2005.

Compare those results to the results reported in the descriptive output file for this run.

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Aggregating DATABASE Output
(DAILY OUTPUT)

- Daily output results in emissions being reported for each vehicle type, model year, facility type, etc.

- To generate an average g/mi emission rate by vehicle type, model-year specific g/mi emission rates need to be properly weighted (a simple average across all MY **<u>is not</u>** correct)

- Recall (from Day 1) that this weighting factor is the travel fraction

- Although travel fraction is not reported, it can be calculated from the MILES and REGDIST fields:

$$TF_{MY} = (MILES_{MY} * REGDIST_{MY}) \, / \, \Sigma \, (MILES_{MY} * REGDIST_{MY})$$

- Alternatively, the average g/day estimates can be divided by the average mi/day to arrive at g/mi:

$$G\_MI_{Ave} = \Sigma \, (GM\_DAY_{MY} * REGDIST_{MY}) \, / \, \Sigma \, (MILES_{MY} * REGDIST_{MY})$$

- These calcs are performed for each facility type

Sample DATABASE Output Using the DAILY OUTPUT Command

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	FILE	RUN	SCEN	POL	VTYPE	ETYPE	FTYPE	AGE	GM_MILE	GM_DAY	STARTS	ENDS	MILES	MPG	FACVMT	REGDIST	VCOUNT	MYR	
2	1	1	1	1	1	1	1	24	4.1236	51.959	7.28	5.3783	12.6006	14.58	0.3421	0.0106	113.772	1976	
3	1	1	1	1	1	1	1	23	5.3307	70.657	7.28	5.3783	13.2548	15.32	0.3421	0.0037	113.772	1977	
4	1	1	1	1	1	1	1	22	5.2978	73.864	7.28	5.3783	13.9425	16.55	0.3421	0.0046	113.772	1978	
5	1	1	1	1	1	1	1	21	5.2162	76.507	7.28	5.3783	14.6672	16.83	0.3421	0.0058	113.772	1979	
6	1	1	1	1	1	1	1	20	2.855	44.048	7.28	5.3783	15.4283	19.42	0.3421	0.0072	113.772	1980	
7	1	1	1	1	1	1	1	19	1.7922	29.085	7.28	5.3783	16.229	20.74	0.3421	0.0087	113.772	1981	
8	1	1	1	1	1	1	1	18	1.7966	30.669	7.28	5.3783	17.0709	21.55	0.3421	0.0113	113.772	1982	
9	1	1	1	1	1	1	1	17	1.3002	23.348	7.28	5.3783	17.958	21.52	0.3421	0.0146	113.772	1983	
10	1	1	1	1	1	1	1	16	1.219	23.026	7.28	5.3783	18.8896	21.85	0.3421	0.0185	113.772	1984	
11	1	1	1	1	1	1	1	15	1.1414	22.679	7.28	5.3783	19.8691	22.47	0.3421	0.0235	113.772	1985	
12	1	1	1	1	1	1	1	14	0.8853	18.502	7.28	5.3783	20.9	23.21	0.3421	0.0299	113.772	1986	
13	1	1	1	1	1	1	1	13	0.85	18.688	7.28	5.3783	21.9851	23.42	0.3421	0.0377	113.772	1987	
14	1	1	1	1	1	1	1	12	0.4943	11.433	7.28	5.3783	23.127	23.74	0.3421	0.0476	113.772	1988	
15	1	1	1	1	1	1	1	11	0.4813	11.708	7.28	5.3783	24.3264	23.31	0.3421	0.056	113.772	1989	
16	1	1	1	1	1	1	1	10	0.4524	11.576	7.28	5.3783	25.5895	23.03	0.3421	0.0611	113.772	1990	
17	1	1	1	1	1	1	1	9	0.4319	11.626	7.28	5.3783	26.9184	22.73	0.3421	0.0651	113.772	1991	
18	1	1	1	1	1	1	1	8	0.414	11.722	7.28	5.3783	28.3152	22.71	0.3421	0.0681	113.772	1992	
19	1	1	1	1	1	1	1	7	0.3895	11.602	7.28	5.3783	29.7845	22.68	0.3421	0.0703	113.772	1993	
20	1	1	1	1	1	1	1	6	0.3946	12.361	7.28	5.3783	31.3298	22.66	0.3421	0.0717	113.772	1994	
21	1	1	1	1	1	1	1	5	0.3924	12.932	7.28	5.3783	32.956	22.64	0.3421	0.0726	113.772	1995	
22	1	1	1	1	1	1	1	4	0.368	12.756	7.28	5.3783	34.6665	22.64	0.3421	0.0731	113.772	1996	
23	1	1	1	1	1	1	1	3	0.3199	11.667	7.28	5.3783	36.466	22.64	0.3421	0.0733	113.772	1997	
24	1	1	1	1	1	1	1	2	0.2665	10.224	7.28	5.3783	38.3579	22.64	0.3421	0.0734	113.772	1998	
25	1	1	1	1	1	1	1	1	0.2124	8.569	7.28	5.3783	40.3492	22.64	0.3421	0.0734	113.772	1999	
26	1	1	1	1	1	1	1	0	0.1771	7.237	7.28	5.3783	40.8534	22.64	0.3421	0.0184	113.772	2000	
27	1	1	1	1	2	1	1	24	5.5168	40.817	8.06	5.7531	7.3987	12.05	0.3421	0.0369	12.5762	1976	
28	1	1	1	1	2	1	1	23	7.1961	59.827	8.06	5.7531	8.3138	13.09	0.3421	0.0072	12.5762	1977	
29	1	1	1	1	2	1	1	22	7.1377	66.549	8.06	5.7531	9.3235	12.78	0.3421	0.0073	12.5762	1978	
30	1	1	1	1	2	1	1	21	6.7968	70.88	8.06	5.7531	10.4284	12.31	0.3421	0.0076	12.5762	1979	
31	1	1	1	1	2	1	1	20	6.5437	76.111	8.06	5.7531	11.6313	15.3	0.3421	0.0078	12.5762	1980	
32	1	1	1	1	2	1	1	19	2.7321	35.323	8.06	5.7531	12.9287	16.43	0.3421	0.0079	12.5762	1981	
33	1	1	1	1	2	1	1	18	2.7091	38.798	8.06	5.7531	14.3213	16.77	0.3421	0.0083	12.5762	1982	
34	1	1	1	1	2	1	1	17	2.6241	41.493	8.06	5.7531	15.8119	17.31	0.3421	0.0109	12.5762	1983	
35	1	1	1	1	2	1	1	16	1.4268	24.823	8.06	5.7531	17.3969	17.02	0.3421	0.0152	12.5762	1984	
36	1	1	1	1	2	1	1	15	1.4096	26.89	8.06	5.7531	19.0773	17.16	0.3421	0.0203	12.5762	1985	

DB_DAY

Aggregating DATABASE Output

- As noted on Day 2 of training, there are a number of DATABASE commands that will limit the output records produced:

Command	**Comment**	**Add'l Data?**
POLLUTANTS	Specifies pollutants	Yes
DATABASE EMISSIONS	Specifies emission types	Yes
DATABASE FACILITIES	Specifies roadway types	Yes
DATABASE VEHICLES	Specifies vehicle classes	Yes
DATABASE YEARS	Specifies model years	Yes
DATABASE AGES	Specifies vehicle ages	Yes
DATABASE HOURS	Specifies hours of the day	Yes
DAILY OUTPUT	Average daily emissions	No
AGGREGATED OUTPUT	Aggregates ages, MY, etc.	No

- The format of the above commands are reprinted on the following pages...

DATABASE Commands Limiting Output

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

POLLUTANTS : `HC CO NOX`

First Pollutant · Second Pollutant · Third Pollutant

Options:
- HC
- CO
- NOX

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

DATABASE EMISSIONS : `2222 1111`

(2=ON; 1=OFF)

Exh Running · Exh Starting · Hot Soak · Diurnal · Evp Resting · Evp Running Loss · Crankcase · Refueling

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

DATABASE FACILITIES: `LOCAL RAMP ETC...`

First Facility Type · Second Facility Type, etc.

Options:
- ARTERIAL
- FREEWAY
- LOCAL
- RAMP
- NONE (i.e., for exh start and evap processes)

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

DATABASE YEARS : `1990,2000`

(Valid Entries = 1928 to 2050)

First MY · Last MY

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

DATABASE AGES : `09,20`

(Valid Entries = 0 to 24)

First Age · Last Age

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

DATABASE HOURS : `09,20`

(Valid Entries = 0 to 24)

First Hour · Last Hour

```
1  2  3  4  5  6  7  8 ..... 20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35 ....
```

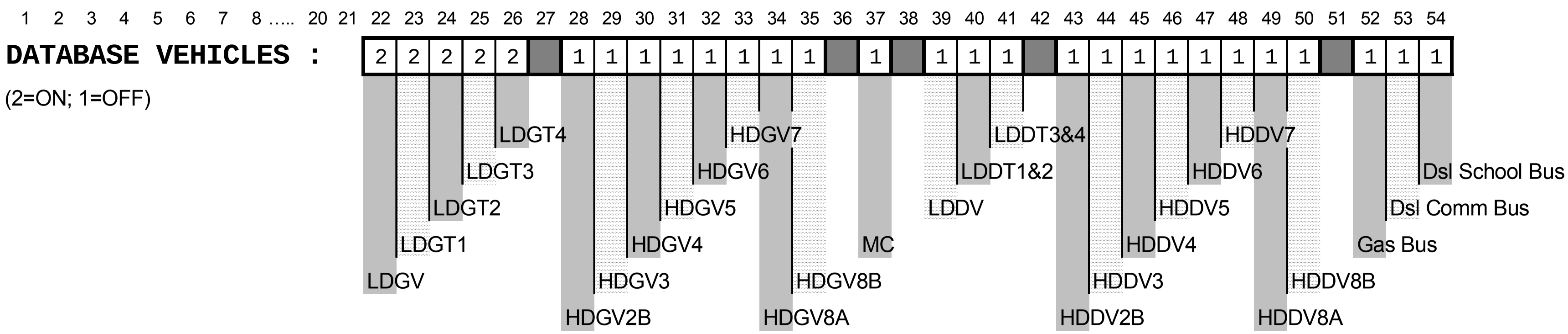
DAILY OUTPUT :

AGGREGATED OUTPUT :

No data entry required

Database Output – Specifying Vehicle Types

Commands Limiting Output (Continued)



Example 16

Using DATABASE OUTPUT and related DATABASE commands, generate LDGT2 fleet-average running and starting NOx emission rates for calendar year 2005.

Compare those results to the results reported in the descriptive output file for this run.

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Aggregating DATABASE Output (HOURLY OUTPUT)

- Hourly output is the most disaggregated form of DATABASE output
- The methods used to aggregate hourly output are similar to those required for daily output
- Only difference is that hourly results must first be aggregated into daily results with the HRVMT field

Sample DATABASE Output Showing Hourly Output

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	FILE	RUN	SCEN	POL	VTYP	ETYP	FTYP	AGE	HOUR	GM_MILI	GM_HOU	STARTS	ENDS	MILES	MPG	HRVMT	FACVMT	REGDIST	VCOUNT	AMBT	DIURTI	MYR
2	1	1	1	1	1	1	1	24	1	3.6064	2.5854	0.1486	0.1254	0.7169	14.58	0.0569	0.392	0.0106	113.772	72	72	1976
3	1	1	1	1	1	1	1	24	2	3.6226	3.3775	0.4034	0.3255	0.9323	14.58	0.074	0.344	0.0106	113.772	72.4	72.4	1976
4	1	1	1	1	1	1	1	24	3	3.4273	2.8327	0.4389	0.3389	0.8265	14.58	0.0656	0.338	0.0106	113.772	74.9	74.9	1976
5	1	1	1	1	1	1	1	24	4	3.497	2.4453	0.344	0.2486	0.6993	14.58	0.0555	0.349	0.0106	113.772	78.9	78.9	1976
6	1	1	1	1	1	1	1	24	5	3.7156	2.528	0.376	0.2733	0.6804	14.58	0.054	0.346	0.0106	113.772	83	83	1976
7	1	1	1	1	1	1	1	24	6	4.0101	2.9405	0.4891	0.34	0.7333	14.58	0.0582	0.333	0.0106	113.772	86.5	86.5	1976
8	1	1	1	1	1	1	1	24	7	4.4482	3.4075	0.5874	0.4196	0.766	14.58	0.0608	0.324	0.0106	113.772	89.6	89.6	1976
9	1	1	1	1	1	1	1	24	8	4.5765	3.2924	0.5314	0.3938	0.7194	14.58	0.0571	0.334	0.0106	113.772	91.3	91.3	1976
10	1	1	1	1	1	1	1	24	9	4.7254	3.5603	0.5851	0.4234	0.7534	14.58	0.0598	0.334	0.0106	113.772	91.8	91.8	1976
11	1	1	1	1	1	1	1	24	10	4.9169	3.94	0.6537	0.4643	0.8013	14.58	0.0636	0.32	0.0106	113.772	92	92	1976
12	1	1	1	1	1	1	1	24	11	5.9086	5.7844	0.6126	0.4686	0.979	14.58	0.0777	0.33	0.0106	113.772	91.6	91.6	1976
13	1	1	1	1	1	1	1	24	12	5.0356	4.6315	0.5623	0.4299	0.9198	14.58	0.073	0.312	0.0106	113.772	90.4	90.4	1976
14	1	1	1	1	1	1	1	24	13	4.4488	2.8082	0.4377	0.3163	0.6312	14.58	0.0501	0.295	0.0106	113.772	88.4	88.4	1976
15	1	1	1	1	1	1	1	24	14	3.9879	1.9545	0.1009	0.0737	0.4901	14.58	0.0389	0.31	0.0106	113.772	85.8	85.8	1976
16	1	1	1	1	1	1	1	24	15	3.5851	1.3912	0.1009	0.0737	0.3881	14.58	0.0308	0.329	0.0106	113.772	83.3	83.3	1976
17	1	1	1	1	1	1	1	24	16	3.2361	1.0764	0.1009	0.0737	0.3326	14.58	0.0264	0.343	0.0106	113.772	81	81	1976
18	1	1	1	1	1	1	1	24	17	3.0173	0.7375	0.1009	0.0737	0.2444	14.58	0.0194	0.381	0.0106	113.772	79.4	79.4	1976
19	1	1	1	1	1	1	1	24	18	2.8538	0.5178	0.1009	0.0737	0.1814	14.58	0.0144	0.405	0.0106	113.772	77.8	77.8	1976
20	1	1	1	1	1	1	1	24	19	2.704	0.3679	0.1009	0.0737	0.1361	14.58	0.0108	0.426	0.0106	113.772	76.3	76.3	1976
21	1	1	1	1	1	1	1	24	20	2.6209	0.284	0.1009	0.0737	0.1084	14.58	0.0086	0.443	0.0106	113.772	75.2	75.2	1976
22	1	1	1	1	1	1	1	24	21	2.606	0.266	0.1009	0.0737	0.1021	14.58	0.0081	0.457	0.0106	113.772	74.3	74.3	1976
23	1	1	1	1	1	1	1	24	22	2.6209	0.2642	0.1009	0.0737	0.1008	14.58	0.008	0.461	0.0106	113.772	73.6	73.6	1976
24	1	1	1	1	1	1	1	24	23	2.6741	0.3302	0.1009	0.0737	0.1235	14.58	0.0098	0.453	0.0106	113.772	73.1	73.1	1976
25	1	1	1	1	1	1	1	24	24	2.713	0.6358	0.1009	0.0737	0.2343	14.58	0.0186	0.418	0.0106	113.772	72.5	72.5	1976
26	1	1	1	1	1	1	2	24	1	3.6048	2.5843	0.1486	0.1254	0.7169	14.58	0.0569	0.457	0.0106	113.772	72	72	1976
27	1	1	1	1	1	1	2	24	2	3.7812	3.5254	0.4034	0.3255	0.9323	14.58	0.074	0.497	0.0106	113.772	72.4	72.4	1976
28	1	1	1	1	1	1	2	24	3	3.6183	2.9906	0.4389	0.3389	0.8265	14.58	0.0656	0.497	0.0106	113.772	74.9	74.9	1976
29	1	1	1	1	1	1	2	24	4	3.8862	2.7175	0.344	0.2486	0.6993	14.58	0.0555	0.492	0.0106	113.772	78.9	78.9	1976
30	1	1	1	1	1	1	2	24	5	4.3066	2.93	0.376	0.2733	0.6804	14.58	0.054	0.497	0.0106	113.772	83	83	1976
31	1	1	1	1	1	1	2	24	6	4.7919	3.5138	0.4891	0.34	0.7333	14.58	0.0582	0.509	0.0106	113.772	86.5	86.5	1976
32	1	1	1	1	1	1	2	24	7	5.246	4.0186	0.5874	0.4196	0.766	14.58	0.0608	0.516	0.0106	113.772	89.6	89.6	1976
33	1	1	1	1	1	1	2	24	8	5.3738	3.8661	0.5314	0.3938	0.7194	14.58	0.0571	0.506	0.0106	113.772	91.3	91.3	1976
34	1	1	1	1	1	1	2	24	9	5.4782	4.1275	0.5851	0.4234	0.7534	14.58	0.0598	0.506	0.0106	113.772	91.8	91.8	1976
35	1	1	1	1	1	1	2	24	10	5.6331	4.5139	0.6537	0.4643	0.8013	14.58	0.0636	0.519	0.0106	113.772	92	92	1976
36	1	1	1	1	1	1	2	24	11	5.9795	5.8537	0.6126	0.4686	0.979	14.58	0.0777	0.506	0.0106	113.772	91.6	91.6	1976
37	1	1	1	1	1	1	2	24	12	5.6417	5.1889	0.5623	0.4299	0.9198	14.58	0.073	0.521	0.0106	113.772	90.4	90.4	1976

DB_HOUR

Example 17

Using DATABASE OUTPUT and related DATABASE commands, generate hourly diurnal and resting loss emission rates for 1999 and 1994 model year LDGVs in calendar year 2005.

Plot the hourly combined diurnal + resting loss VOC emission rates for the two model years along with the diurnal temperature profile.

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Working with Model Year Output

- Needed for many control measure analyses
- The approach for aggregating model year output into a fleet-average result was described above
  - Generate travel fractions
  - Compile fleet-average emission factors
- Similarly, Database output can be used to generate vehicle lifetime emission rates (often needed for cost-effectiveness calculations)

Vehicle Lifetime Emissions Estimates

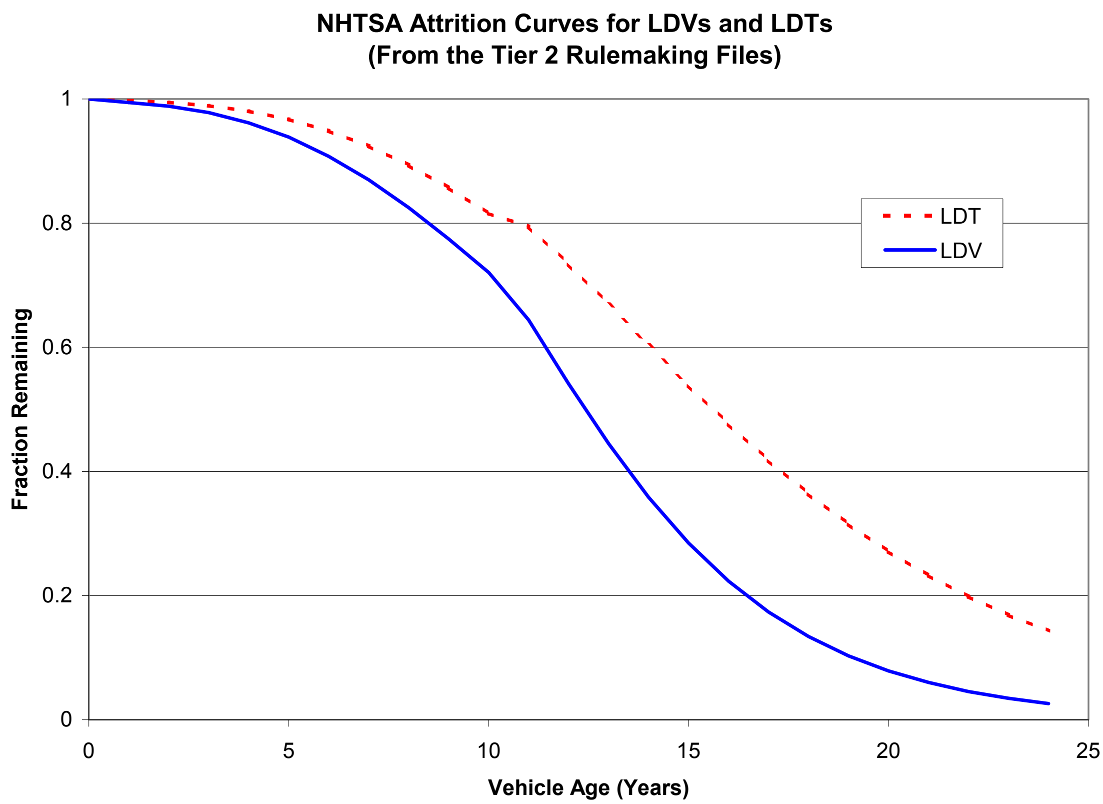
- "Quick and Dirty" Method
  - Assume a 10-year life
  - Generate emission factors for years 1 to 10
  - Apply annual mileage accumulation rates (function of age) to the emission factors
  - Sum over the 10-year life

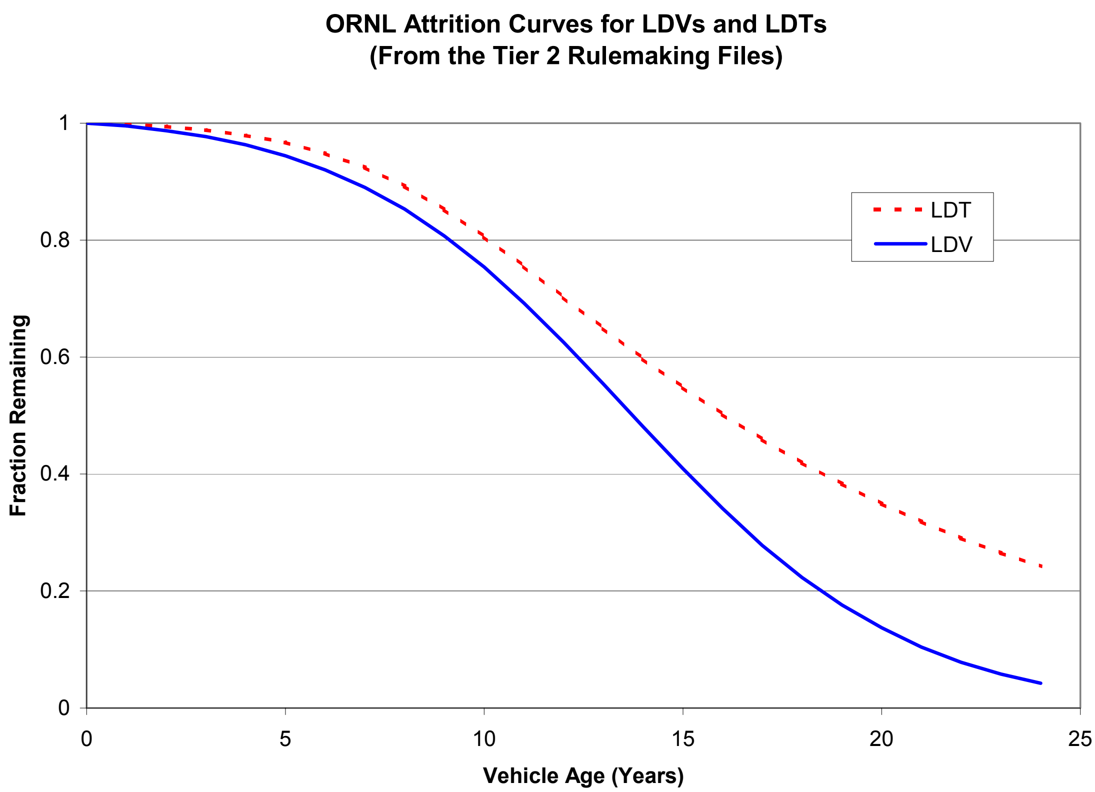
- More Precise Method
  - Assume a 25-year life
  - Generate emission factors for years 1 to 25
  - Apply annual mileage accumulation rates (function of age) to the emission factors
  - Apply survival curve to each vehicle age
  - Discount HC/NOx for ozone season
  - Discount CO for CO season
  - Discount emissions to present value
  - Sum over the 25-year life

- Depending on the purpose of the analysis, discounting is sometimes ignored

Vehicle Survival/Attrition Curves

- Several sources of vehicle survival/attrition curves:
  - ORNL and NHTSA (used in Tier 2 rulemaking)
  - CARB's EMFAC model
  - Possibly through analysis of DMV data
- For this course, we will use the NHTSA curves


NHTSA Attrition Curves for LDVs and LDTs
(From the Tier 2 Rulemaking Files)
Fraction Remaining
Vehicle Age (Years)
LDT
LDV
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25


ORNL Attrition Curves for LDVs and LDTs
(From the Tier 2 Rulemaking Files)
Fraction Remaining
Vehicle Age (Years)
LDT
LDV
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25

Sample Spreadsheet
Lifetime NOx Emissions from a Tier 2 LDGV

	B	C	D	E	G	H
131	**Lifetime NOx Emissions from a Tier 2 LDGV**					
132	**(Emission Factors Based on MOBILE6 without I/M)**					
133						
134		NHTSA			Annual NOx (lb/yr)	
135		Attrition	Annual	NOx	No	With
136	AGE	Curve	Miles	(g/mi)	Attrition	Attrition
137	0	1.000		0.025		
138	1	0.995	14911	0.029	0.894	0.891
139	2	0.988	14727	0.040	1.132	1.122
140	3	0.978	14001	0.077	1.810	1.780
141	4	0.962	13310	0.114	2.798	2.714
142	5	0.938	12653	0.151	3.699	3.514
143	6	0.908	12029	0.190	4.522	4.174
144	7	0.870	11435	0.232	5.311	4.721
145	8	0.825	10871	0.274	6.062	5.138
146	9	0.775	10335	0.318	6.748	5.398
147	10	0.721	9825	0.363	7.376	5.515
148	11	0.644	9340	0.409	7.947	5.422
149	12	0.541	8879	0.456	8.465	5.017
150	13	0.445	8441	0.503	8.926	4.400
151	14	0.358	8025	0.553	9.343	3.751
152	15	0.285	7629	0.604	9.727	3.127
153	16	0.223	7252	0.656	10.072	2.557
154	17	0.174	6895	0.710	10.382	2.060
155	18	0.134	6555	0.764	10.651	1.638
156	19	0.103	6231	0.821	10.889	1.290
157	20	0.079	5924	0.880	11.106	1.008
158	21	0.060	5631	0.940	11.298	0.783
159	22	0.046	5354	1.003	11.465	0.605
160	23	0.035	5089	1.067	11.609	0.465
161	24	0.026	4838	1.133	11.733	0.357
162						
163			**Lifetime NOx Emissions (lbs.):**		**184**	**67**

DB_TIER2

Example 18

Using DATABASE OUTPUT and related DATABASE commands, generate vehicle lifetime VOC (exhaust and evap separate) and NOx emissions estimates for a Tier 2 LDGV. Use the NHTSA attrition curve. Also generate the net present value of emissions reductions using a discount rate of 7%. (Results to be used later.)

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

IX. CONTROL MEASURE ANALYSIS

Control Measure Analysis
Measures Analyzed Directly with MOBILE6

- I/M program changes
- Fuel property changes
- Tier 2 (fuels and vehicles)
- California LEVs and fleet rules
- Natural gas vehicles
- HDDV emission standards

Control Measure Analysis
Measures Requiring "Off-Model" Calculations

- Vehicle scrappage
- Catalyst/oxygen sensor replacement program
- Rebuild/Retrofit programs
- Gas cap replacement program
- Canister replacement program

Issues to Consider

- How long will benefit last (e.g., scrappage, catalyst replacement)?
- Does the measure result in a net reduction, or are emissions shifted (e.g., fleet rules)?
- Will the reduction occur anyway (e.g., certain fuels measures are somewhat dubious because of Tier 2 sulfur control)?
- Can the measure be reasonably implemented?
- What are the costs of the measure?
- Where does one get data for off-model analyses?
- Is it important to use local data in the calculations?

MEASURES ANALYZED DIRECTLY WITH MOBILE6

I/M Program Measures

- Implementation of an I/M program, or I/M program changes, is one of the most common of locally developed measures

- There is a vast array of program features that must be considered, many of which impact the benefits of the program:

  - Test frequency
  - Test type and cutpoint stringency
  - Model year coverage
  - Vehicle type coverage
  - Program type (test-only vs. test-and-repair)
  - Repair cost ceiling/waiver rate
  - Technician training and certification

- The impact of some of these will be investigated in the example that follows

Example 19

Determine the impact on CY2005 LDGV fleet-average emissions of changing from an annual idle I/M program to a biennial 2-mode ASM program using phase-in cutpoints.

Assuming that test costs increase from $12 to $20, what is the test cost differential for the LDGV fleet?

How do the emissions results change if OBD testing is applied to 1996 and newer model year vehicles instead of ASM testing? Assume $14 for an OBD inspection.

How do the emission results and test costs change if the first inspection is performed at age 5?

Temperature: 72˚F to 92˚F
RVP: 8.7 psi
Evaluation month: July
Program start year: 1983
Model year coverage: All
Waiver rate: 8%
Compliance rate: 95%
Stringency: 20%
No TTC Credits

Fuel Property Changes

- Fuel property changes can also be implemented by state and local agencies
- The most common fuel measures are:
  - Winter oxygenate
  - RFG opt-in
  - RVP control

Example 20

Determine the impact on CY2005 fleet-average emissions of reducing maximum RVP from 9.0 to 7.0 psi.

Assuming that this level of control will cost 2.5 cents per gallon, what is the cost-effectiveness of this measure?

Temperature: 72°F to 92°F
Evaluation month: July
RVP: 8.7 psi (9.0 psi limit)
RVP: 6.9 psi (7.0 psi limit)

New Light-Duty Vehicle Controls (Tier 2 and LEVs)

- MOBILE6 is configured to allow users the option of entering alternative implementation schedules for Tier 2 and LEV-category vehicles (similar to the PROMPT=5 flag in MOBILE5)

- This allows for relatively easy modeling of the emissions impacts of different new vehicle standards

- However, it is likely that the most common use of these features will be to model the impacts of the California LEV program

- That is because the Clean Air Act prevents states from adopting standards that would result in a "Third Car"

- Recall that MOBILE6 rule implementation commands were briefly covered on Day 2 (see next page for summary of commands)

Summary of MOBILE6 Rule Implementation Commands

MOBILE6 Command	Header/ Run/ Scenario?	Comment
NGV FRACTION : NGVFR.D[a]	R	Natural Gas Vehicle Fractions
NGV EF : NGVEF2.D	R	NGV Emission Factors
NO CLEAN AIR ACT :	R	Turn Off Effects of 1990 CAAA
94+ LDG IMP : P94IMP.D	R	Alt Tier 1/LEV Implementation
NO TIER 2 :	R	Turn Off Effects of Tier 2 Rule
T2 CERT : T2CERT.D	R	Alt Tier 2 Stds (for CA LEV II Rule)
T2 EXH PHASE-IN : T2EXH.D	R	Alt Phase-in Fractions for Exhaust
T2 EVAP PHASE-IN : T2EVAP.D	R	Alt Phase-in Fractions for Evap
NO DEFEAT DEVICE :	R	Turn Off Effects of HDDV Off-Cycle
NO NOX PULL AHEAD :	R	Turn Off HDDV NOx Pull Ahead
NO REBUILD :	R	Turn Off HDDV Rebuild Program
REBUILD EFFECTS : 0.50	R	Alt Effectiveness of Rebuild
NO 2007 HDDV RULE :	R	Turn Off 2007 HDDV Rule

[a] File names refer to the default, or template, files provided with the model.

MOBILE6 Commands that Impact Tier 2 and LEV Implementation

- `NO TIER 2 :`

  Turns off the impact of Tier 2, including fuel requirements; continues the NLEV program through 2050 with default CY2000 sulfur levels

- `T2 EXH PHASE-IN : T2EXH.D`

  Replaces the default phase-in fractions for Tier 2 exhaust standards, allowing different phase-in schedules to be modeled

- `T2 EVAP PHASE-IN : T2EVAP.D`

  Replaces the default phase-in fractions for Tier 2 evaporative standards, allowing different phase-in schedules to be modeled

- `T2 CERT : T2CERT.D`

  Allows user to specify alternative Tier 2 50,000-mile emission standards (used to model LEV II)

- `94+ LDG IMP : P94IMP.D`

  Allows optional 1994 and later fleet fractions for Tier 1, NLEV (or CA LEV), and Tier 2 standards

94+ LDG IMP Command

- This command (and the P94IMP.D file) is very similar to PROMPT=5 and NLEV.D file from MOBILE5:

```
* P94IMP.D File from MOBILE6 distribution disk
* LDGV
* T0    T1     T1     T2    TLEV  TLEV  LEV    LEV    ULEV  ULEV  ZEV
*      (int)              (int)        (int)         (int)
  0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /94
  0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /95
  0.0   0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /96
  0.0   0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /97
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /98
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /99
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /00
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0  /01
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0  /02
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0  /03
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /04
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /05
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /06
   .
   .
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /25

* LDGT1
  0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /94
  0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /95
  0.0   0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /96
  0.0   0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /97
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /98
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /99
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /00
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0  /01
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0  /02
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0  /03
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /04
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /05
  0.0   0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  /06
   .
   .
   .
```

Example 21

Modify the P94IMP.D file to reflect the NLEV phase-in percentages for the Northeast and compare VOC and NOx results from a CY2005 run to the default MOBILE6 estimates.

Assume the following Northeast implementation:

1999 MY = 40% Tier 1 / 60% LEV
2000 MY = 10% Tier 1 / 90% LEV
2001 MY = 100% LEV

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Example 22

Using DATABASE OUTPUT and related DATABASE commands, generate vehicle lifetime VOC (exhaust and evap separate) and NOx emissions estimates for LDGVs certified to NLEV emission standards. Use the NHTSA attrition curve. Calculate the net present value of the emission reductions using a discount rate of 7%. (See Example 18.)

Compare these results to the lifetime emissions from Tier 2 vehicles calculated in Example 18.

If the cost of Tier 2 control relative to NLEV for LDGVs is $100 per vehicle and the fuel cost differential is 2 cents per gallon, what is the incremental cost-effectiveness of Tier 2 control (use the net present value of emissions and costs)?

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Example 23

If a light-duty natural gas vehicle (NGV) is certified to Tier 2 exhaust emission standards, what are the lifetime evaporative benefits from that vehicle? (See Example 18.) If the cost differential for an NGV is $2,000, what is the cost-effectiveness of implementing NGVs? (Ignore fuel cost differences.)

If a zero-emission vehicle costs $21,000 more than a Tier 2 vehicle, what is the cost-effectiveness of implementing ZEVs? (Ignore power plant emissions, assume a ZEV fully replaces a conventional vehicle, and ignore the impact that higher new vehicle costs will have on the retention of older vehicles.)

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Modifying Tier 2 Implementation

- The most likely use of this feature is to model the impacts of the California LEV II program (e.g., in New York and Massachusetts)

- EPA has not yet issued guidance on how to properly modify the Tier 2 schedule to reflect the LEV II program

- As a result, we will just introduce the mechanics of making this change

- The following commands are used, and the appropriate revisions to the data files would need to be made:

```
T2 EXH PHASE-IN     : T2EXH.D
T2 EVAP PHASE-IN    : T2EVAP.D
T2 CERT             : T2CERT.D
```

Natural Gas Vehicles

- The per-vehicle lifetime emissions and cost-effectiveness of light-duty NGVs was discussed in Example 23 (assuming the only benefit was for evap)

- It is also possible to estimate the impact of NGVs on fleet-average emissions directly with MOBILE6 using the following commands:

```
NGV FRACTION          : NGVFR.D
NGV EF                : NGVEF2.D
```

- NGVFR.D allows the user to specify the percent of NGVs in each of 28 vehicle classes for model years 1994 to 2050

- NGVEF2.D allows the user to enter alternate NGV emission factors for each of 28 vehicle classes, three pollutants, and for running and start emissions (where applicable); it does not allow emission factors by model year

- Beware of MY2004+ default emission factors for NGVs

Example 24
(Time Permitting)

Assume that 10% of the LDGV fleet sold between 1998 and 2003 consisted of NGVs. Modify the NGVFR.D file to reflect this and run MOBILE6. What is the impact on fleet-average VOC, CO, and NOx emissions?

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

MEASURES REQUIRING “OFF-MODEL” CALCULATIONS

Control Measure Analysis
Measures Requiring "Off-Model" Calculations

- Vehicle scrappage
- Rebuild/Retrofit programs
- Catalyst/oxygen sensor replacement program
- Gas cap replacement program
- Canister replacement program
- etc.

“Off-Model” Analyses

- Although the measures analyzed directly with MOBILE6 sometimes needed additional spreadsheet work, the estimates were based directly on output from MOBILE6

- In certain cases it becomes necessary to perform analyses outside the model

- These measures are typically analyzed by:

  - Preparing baseline model year output;

  - Modifying the emission factors, registration distribution, and/or travel fraction to account for the impact of the proposed control measure; and

  - Recalculating the fleet-average emission rate.

Example 25

Using the input file from Example 16, run MOBILE6 to obtain LDGV model-year specific VOC, CO, and NOx emission rates for calendar year 2005. Also obtain model-year specific NOx estimates for Class 8B HDDVs.

Set up a spreadsheet to generate fleet-average VOC, CO, and NOx emission rates for LDGVs, and a spreadsheet to generate fleet-average NOx emission rates for Class 8B HDDVs.

Temperature: 72°F to 92°F
RVP: 8.7 psi
Evaluation month: July

Accelerated Vehicle Retirement (Vehicle Scrappage)

- Because of the high emissions associated with older vehicles, vehicle scrappage is sometimes considered as a potential control strategy

- Under a scrappage program, old vehicles are purchased for a set bounty (e.g., $500 or $1,000) and are removed from the road

- In the simplest case, it is assumed that:

  - Scrapped vehicles have an emission rate equivalent to an average vehicle of the same age

  - Overall fleet VMT is conserved (i.e., the miles lost from the scrapped vehicle are made up by other vehicles)

  - Replacement vehicle VMT is equivalent to the overall fleet-average emission rate

- Under the above case, a scrappage program can be evaluated by simply modifying the registration distribution

Example 26

Using the spreadsheet generated in Example 25, estimate the LDGV fleet-average VOC, CO, and NOx emission benefits of a scrappage program. Assume that 5% of the 15 year and older vehicle have been removed from the fleet by 2005 and are replaced with fleet average vehicles.

Retrofit/Rebuild Programs

- Retrofit or rebuild programs are also sometimes considered viable options for additional control of the in-use fleet

- Most recently, the focus has been on rebuild programs aimed at heavy-duty Diesel vehicles

- The approach for analyzing the emissions impacts of such a measure consists of:

  - Determining how many vehicles have been retrofit;

  - Determining the per-vehicle emissions impact;

  - Modifying the model-year specific emission rate accordingly; and

  - Recalculating the fleet-average emission rate with the same travel fraction.

Example 27

Using the spreadsheet generated in Example 25, estimate the benefits of a rebuild/retrofit program aimed at 1990 through 1997 model year Class 8B HDDVs. Assume that 20% of the fleet would have been rebuilt by 2005, and that the rebuild would result in a decrease in NOx emissions of 60%.

More Detailed “Off-Model” Analyses

- The above two examples were fairly simple in terms of analysis techniques
- Although the same general principals apply to most off-model analyses, there are certain cases in which the model-year specific emission rates need to be carefully evaluated
- This often requires one to break-out normal emitters from high emitters (e.g., for an oxygen sensor replacement program), repair the highs, and recalculate fleet-average emissions
- The most direct way to accomplish this is to review the source code and place WRITE statements at suitable locations
- Unfortunately, that level of detail is beyond the scope of this course