MOBILE6
Day 4 Examples

MOBILE6
On-Road Motor Vehicle
Emissions Model

Training Course

Sierra Research, Inc.
September 2001

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

Example 15 Input File (Page 1 of 1)

```
* Filename: Exam_15.in
* This input generates the summer fleet-average VOC, CO and NOx
* emissions for calendar year 2005 using the DATABASE command.

******************  Header Section  ************************
MOBILE6 INPUT FILE :

* Indicate database output
DATABASE OUTPUT    :
WITH FIELDNAMES    :
AGGREGATED OUTPUT  :

RUN DATA           :

******************  Run Section  ***************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

******************  Scenario Section  **********************
SCENARIO RECORD    : Summer Fleet-Average Emission - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of This Run  ***********************
END OF RUN
```

Example 15 Database Output (Page 1 of 1)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	FILE	RUN	SCEN	CAL_YEAR	POL	VTYPE	GM_MILE	GM_DAY	STARTS	ENDS	MILES	MPG	VMT	VMT*G/MI	Sum Over	
2	1	1	1	2005	1	1	1.4995	43.741	7.28	5.3799	29.1701	22.66	0.415838	0.624	All Vehicle	
3	1	1	1	2005	1	2	1.4614	50.992	8.06	5.7548	34.8925	16.89	0.078249	0.114	Classes	
4	1	1	1	2005	1	3	1.5041	52.48	8.06	5.7548	34.8925	16.89	0.26049	0.392		
5	1	1	1	2005	1	4	2.2997	78.091	8.06	5.7548	33.9569	16.66	0.079782	0.183		
6	1	1	1	2005	1	5	2.3481	79.734	6.88	4.9123	33.9569	16.66	0.03669	0.086		
7	1	1	1	2005	1	6	1.9281	69.608	6.88	4.9123	36.1025	10.48	0.029721	0.057		
8	1	1	1	2005	1	7	2.5864	88.708	6.88	4.9123	34.298	10.45	0.001052	0.003		
9	1	1	1	2005	1	8	5.7055	113.44	6.88	4.9123	19.8824	10.35	0.000422	0.002		
10	1	1	1	2005	1	9	3.2366	88.282	6.88	4.9123	27.2758	10.45	0.001091	0.004		
11	1	1	1	2005	1	10	3.0308	85.452	6.88	4.9123	28.1946	10.46	0.002314	0.007		
12	1	1	1	2005	1	11	3.5263	94.822	6.88	4.9123	26.8901	10.45	0.000987	0.003		
13	1	1	1	2005	1	12	4.182	102.129	6.88	4.9123	24.4213	10.43	0.000003	0.000		
14	1	1	1	2005	1	13	0	0	0	0	0	0	0	0.000		
15	1	1	1	2005	1	14	0.5778	11.412	8.06	5.7548	19.751	0	0.000557	0.000		
16	1	1	1	2005	1	15	2.5923	17.118	6.65	4.7481	6.6033	0	0.000192	0.000		
17	1	1	1	2005	1	16	0.228	9.608	6.65	4.7481	42.1399	0	0.009222	0.002		
18	1	1	1	2005	1	17	0.2493	11.333	6.65	4.7481	45.4542	0	0.002798	0.001		
19	1	1	1	2005	1	18	0.3064	17.382	6.65	4.7481	56.7227	0	0.002672	0.001		
20	1	1	1	2005	1	19	0.3187	18.804	6.65	4.7481	58.9966	0	0.001226	0.000		
21	1	1	1	2005	1	20	0.4584	26.842	6.65	4.7481	58.558	0	0.006316	0.003		
22	1	1	1	2005	1	21	0.5704	32.204	6.65	4.7481	56.4564	0	0.00923	0.005		
23	1	1	1	2005	1	22	0.549	59.48	6.65	4.7481	108.3384	0	0.011129	0.006		
24	1	1	1	2005	1	23	0.6511	108.876	1.35	0.9639	167.2209	0	0.039698	0.026		
25	1	1	1	2005	1	24	2.4638	24.888	6.88	4.9123	10.1013	0	0.005745	0.014		
26	1	1	1	2005	1	25	8.9911	244.829	6.65	4.7481	27.2301	10.09	0.000336	0.003		
27	1	1	1	2005	1	26	0.5414	52.497	6.65	4.7481	96.9596	0	0.000941	0.001		
28	1	1	1	2005	1	27	0.7333	19.968	8.06	5.7548	27.2301	0	0.001632	0.001		
29	1	1	1	2005	1	28	0.5938	24.311	5.41	3.8627	40.9421	0	0.001666	0.001	1.541	VOC Flt-Ave
30	1	1	1	2005	2	1	13.1068	382.327	8.06	5.9563	29.1701	22.66	0.415838	5.450		
31	1	1	1	2005	2	2	14.704	513.057	8.06	5.7548	34.8925	16.89	0.078249	1.151		

EXAM_15

Example 15 Descriptive Output (Page 1 of 1)

```
*****************************************************************************
* MOBILE6 Draft (17-Aug-2001)                                               *
* Input file: EXAM_15.IN (file 1, run 1).                                   *
*****************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Fleet-Average Emission - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  72.0 (F)
              Maximum Temperature:  92.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   8.7 psi
                    Weathered RVP:   8.3 psi
              Fuel Sulfur Content:   92. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  No
                 Reformulated Gas:  No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
              GVWR:                 <6000     >6000     (All)
                        ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 ---------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.500     1.494     2.315     1.704     2.213     0.578     0.801     0.540      2.46     1.541
     Composite CO  :     13.11     15.13     19.16     16.16     17.68     1.617     1.408     3.046     16.57    13.799
     Composite NOX :      0.947     1.134     1.465     1.219     4.261     1.319     1.371    11.442      1.16     2.083
 ---------------------------------------------------------------------------------------------------------------------------
```

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

Example 16 Input File (Page 1 of 1)

```
* Filename: Exam_16.in
* This input generates the LDGT2 fleet-average running and
* starting NOx emission rates for calendar year 2005 using
* the DATABASE command.

******************  Header Section  ************************
MOBILE6 INPUT FILE :

* Indicate database output
DATABASE OUTPUT    :
WITH FIELDNAMES    :

* Indicate the vehicle class for analysis
DATABASE VEHICLES  : 11211 11111111 1 111 11111111 111

* Use daily results to reduce output volume
DAILY OUTPUT       :

POLLUTANTS         : NOx
RUN DATA           :

******************  Run Section  ***************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

* Show running and starting emissions in descriptive output
EXPAND EXHAUST     :

* Show emissions of LDTs for each of six classes
EXPAND LDT EFS     :

******************  Scenario Section  **********************
SCENARIO RECORD    : Summer Fleet-Average Emission - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of This Run  ***********************
END OF RUN
```

Example 16 Database Output (Sample Page)

	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_MILI	GM_DAY	STARTS	ENDS	MILES	MPG	FACVMT	REGDIST	VCOUNT	MYR	
2	1	1	1	3	3	1	1	24	2.4738	17.262	8.06	5.7531	6.9781	16.43	0.3421	0.0339	55.378	1981	
3	1	1	1	3	3	1	2	24	2.4161	16.86	8.06	5.7531	6.9781	16.43	0.4978	0.0339	55.378	1981	
4	1	1	1	3	3	1	3	24	2.3154	16.157	8.06	5.7531	6.9781	16.43	0.1305	0.0339	55.378	1981	
5	1	1	1	3	3	1	4	24	2.7411	19.128	8.06	5.7531	6.9781	16.43	0.0297	0.0339	55.378	1981	
6	1	1	1	3	3	2	5	24	0.8378	5.846	8.06	5.7531	6.9781	16.43	1	0.0339	55.378	1981	
7	1	1	1	3	3	1	1	23	2.4838	19.483	8.06	5.7531	7.8439	16.77	0.3421	0.0065	55.378	1982	
8	1	1	1	3	3	1	2	23	2.4274	19.04	8.06	5.7531	7.8439	16.77	0.4978	0.0065	55.378	1982	
9	1	1	1	3	3	1	3	23	2.3303	18.279	8.06	5.7531	7.8439	16.77	0.1305	0.0065	55.378	1982	
10	1	1	1	3	3	1	4	23	2.7525	21.59	8.06	5.7531	7.8439	16.77	0.0297	0.0065	55.378	1982	
11	1	1	1	3	3	2	5	23	0.7218	5.662	8.06	5.7531	7.8439	16.77	1	0.0065	55.378	1982	
12	1	1	1	3	3	1	1	22	2.4894	21.924	8.06	5.7531	8.807	17.31	0.3421	0.0071	55.378	1983	
13	1	1	1	3	3	1	2	22	2.4334	21.431	8.06	5.7531	8.807	17.31	0.4978	0.0071	55.378	1983	
14	1	1	1	3	3	1	3	22	2.3371	20.583	8.06	5.7531	8.807	17.31	0.1305	0.0071	55.378	1983	
15	1	1	1	3	3	1	4	22	2.7594	24.302	8.06	5.7531	8.807	17.31	0.0297	0.0071	55.378	1983	
16	1	1	1	3	3	2	5	22	0.6694	5.895	8.06	5.7531	8.807	17.31	1	0.0071	55.378	1983	
17	1	1	1	3	3	1	1	21	1.9228	18.967	8.06	5.7531	9.864	17.02	0.3421	0.0074	55.378	1984	
18	1	1	1	3	3	1	2	21	1.8607	18.354	8.06	5.7531	9.864	17.02	0.4978	0.0074	55.378	1984	
19	1	1	1	3	3	1	3	21	1.7471	17.233	8.06	5.7531	9.864	17.02	0.1305	0.0074	55.378	1984	
20	1	1	1	3	3	1	4	21	2.1981	21.682	8.06	5.7531	9.864	17.02	0.0297	0.0074	55.378	1984	
21	1	1	1	3	3	2	5	21	0.6029	5.947	8.06	5.7531	9.864	17.02	1	0.0074	55.378	1984	
22	1	1	1	3	3	1	1	20	1.949	21.473	8.06	5.7531	11.018	17.16	0.3421	0.0078	55.378	1985	
23	1	1	1	3	3	1	2	20	1.8888	20.81	8.06	5.7531	11.018	17.16	0.4978	0.0078	55.378	1985	
24	1	1	1	3	3	1	3	20	1.7788	19.598	8.06	5.7531	11.018	17.16	0.1305	0.0078	55.378	1985	
25	1	1	1	3	3	1	4	20	2.2266	24.531	8.06	5.7531	11.018	17.16	0.0297	0.0078	55.378	1985	
26	1	1	1	3	3	2	5	20	0.547	6.027	8.06	5.7531	11.018	17.16	1	0.0078	55.378	1985	
27	1	1	1	3	3	1	1	19	2.0063	24.614	8.06	5.7531	12.268	17.88	0.3421	0.0081	55.378	1986	
28	1	1	1	3	3	1	2	19	1.9521	23.949	8.06	5.7531	12.268	17.88	0.4978	0.0081	55.378	1986	
29	1	1	1	3	3	1	3	19	1.8522	22.723	8.06	5.7531	12.268	17.88	0.1305	0.0081	55.378	1986	
30	1	1	1	3	3	1	4	19	2.2885	28.076	8.06	5.7531	12.268	17.88	0.0297	0.0081	55.378	1986	
31	1	1	1	3	3	2	5	19	0.5189	6.366	8.06	5.7531	12.268	17.88	1	0.0081	55.378	1986	
32	1	1	1	3	3	1	1	18	2.0611	28.058	8.06	5.7531	13.613	18.05	0.3421	0.0085	55.378	1987	
33	1	1	1	3	3	1	2	18	2.0122	27.392	8.06	5.7531	13.613	18.05	0.4978	0.0085	55.378	1987	
34	1	1	1	3	3	1	3	18	1.9223	26.169	8.06	5.7531	13.613	18.05	0.1305	0.0085	55.378	1987	
35	1	1	1	3	3	1	4	18	2.3491	31.978	8.06	5.7531	13.613	18.05	0.0297	0.0085	55.378	1987	
36	1	1	1	3	3	2	5	18	0.5016	6.828	8.06	5.7531	13.613	18.05	1	0.0085	55.378	1987	
37	1	1	1	3	3	1	1	17	1.7005	25.6	8.06	5.7531	15.054	17.58	0.3421	0.0107	55.378	1988	
38	1	1	1	3	3	1	2	17	1.6435	24.742	8.06	5.7531	15.054	17.58	0.4978	0.0107	55.378	1988	
39	1	1	1	3	3	1	3	17	1.5427	23.224	8.06	5.7531	15.054	17.58	0.1305	0.0107	55.378	1988	
40	1	1	1	3	3	1	4	17	1.9664	29.603	8.06	5.7531	15.054	17.58	0.0297	0.0107	55.378	1988	
41	1	1	1	3	3	2	5	17	1.1044	16.626	8.06	5.7531	15.054	17.58	1	0.0107	55.378	1988	

EXAM_16

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Example 16 Descriptive Output (Page 1 of 1)

```
************************************************************************
* MOBILE6 Draft (17-Aug-2001)                                          *
* Input file: EXAM_16.IN (file 1, run 1).                              *
************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Fleet-Average Emission - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
               Minimum Temperature:  72.0 (F)
               Maximum Temperature:  92.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   8.7 psi
                     Weathered RVP:   8.3 psi
               Fuel Sulfur Content:   92. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                 <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 ---------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite NOX :      0.947     1.134     1.465     1.219     4.261     1.319     1.371    11.442      1.16     2.083
 ---------------------------------------------------------------------------------------------------------------------
Exhaust emissions (g/mi):

         NOx Start:     0.150     0.192     0.239     0.204               0.072     0.069                 0.367
       NOx Running:     0.798     0.942     1.226     1.015               1.247     1.302                 0.793
  NOx Total Exhaust:    0.947     1.134     1.465     1.219     4.261     1.319     1.371    11.442      1.16     2.083
 ---------------------------------------------------------------------------------------------------------------------
         Veh. Type:     LDGT1     LDGT2     LDGT3     LDGT4    LDDT12    LDDT34
                       ------    ------    ------    ------    ------    ------
           VMT Mix:    0.0782    0.2605    0.0798    0.0367    0.0002    0.0017
---------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite NOX :     0.923     1.197     1.357     1.699     2.726     1.215
---------------------------------------------------------------------------------------------------------------------
Exhaust emissions (g/mi):

         NOx Start:     0.162     0.201     0.225     0.269     0.361     0.036
       NOx Running:     0.762     0.996     1.132     1.430     2.365     1.179
  NOx Total Exhaust:    0.923     1.197     1.357     1.699     2.726     1.215
---------------------------------------------------------------------------------------------------------------------
```

Example 16 Data Analysis (Page 1 of 1)

CY2005 LDGT2 NOx Emissions

Output	NOx Emissions (g/mi)	
	Running	Starting
Database	0.996	0.2012
Descriptive	0.996	0.201

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

Example 17 Input File (Page 1 of 1)

```
* Filename: Exam_17.in
* This input generates the hourly diurnal and resting loss
* emission rates for 1999 and 1994 model year LDGVs in
* calendar year 2005 using the DATABASE command.

******************  Header Section  ************************
MOBILE6 INPUT FILE :

* Indicate database output
DATABASE OUTPUT    :
WITH FIELDNAMES    :

* Indicate the vehicle class for analysis
DATABASE VEHICLES  : 21111 11111111 1 111 11111111 111

*Indicate the emission types to be reported
DATABASE EMISSIONS : 1112 2111

* Indicate the model year range for analysis
DATABASE YEARS     : 1994 1999

RUN DATA           :

******************  Run Section  ***************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

******************  Scenario Section  **********************
SCENARIO RECORD    : Summer Fleet-Average Emission - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of This Run  ***********************
END OF RUN
```

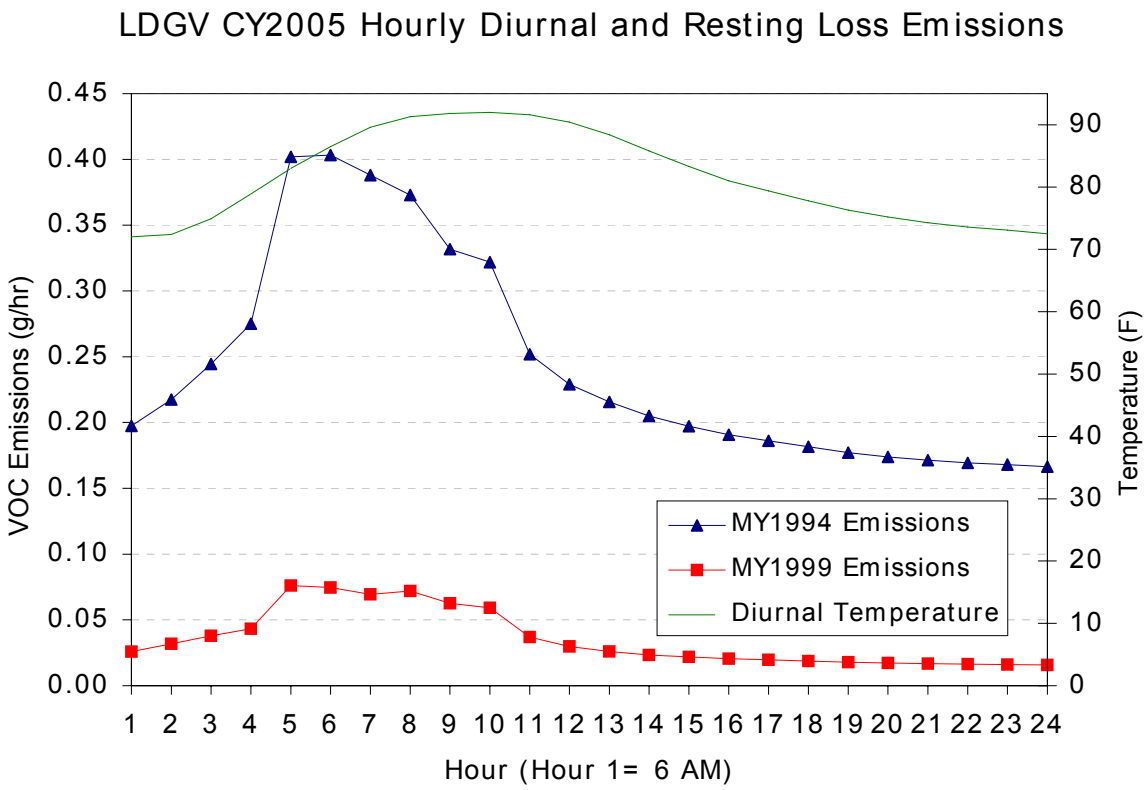
Example 17 Database Output (Sample Page)

Note: Columns A-E are hidden.

	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	ETYPE	FTYPE	AGE	HOUR	GM_MILE	GM_HOUF	STARTS	ENDS	MILES	MPG	HRVMT	FACV	REGDIST	VCOUNT	AMBTEM	DIURTEMI	MYR
2	5	5	11	1	0.1223	0.165	0.1486	0.1254	1.3495	22.66	0.0569	1	0.054	105.7458	72	72	1994
3	5	5	11	2	0.0947	0.1662	0.4034	0.3255	1.7551	22.66	0.074	1	0.054	105.7458	72.4	72.4	1994
4	5	5	11	3	0.1113	0.1731	0.4389	0.3389	1.5558	22.66	0.0656	1	0.054	105.7458	74.9	74.9	1994
5	5	5	11	4	0.14	0.1843	0.344	0.2486	1.3163	22.66	0.0555	1	0.054	105.7458	78.9	78.9	1994
6	5	5	11	5	0.1528	0.1956	0.376	0.2733	1.2807	22.66	0.054	1	0.054	105.7458	83	83	1994
7	5	5	11	6	0.1488	0.2054	0.4891	0.34	1.3803	22.66	0.0582	1	0.054	105.7458	86.5	86.5	1994
8	5	5	11	7	0.1484	0.2139	0.5874	0.4196	1.442	22.66	0.0608	1	0.054	105.7458	89.6	89.6	1994
9	5	5	11	8	0.1614	0.2186	0.5314	0.3938	1.3542	22.66	0.0571	1	0.054	105.7458	91.3	91.3	1994
10	5	5	11	9	0.1553	0.2202	0.5851	0.4234	1.4183	22.66	0.0598	1	0.054	105.7458	91.8	91.8	1994
11	5	5	11	10	0.1463	0.2207	0.6537	0.4643	1.5084	22.66	0.0636	1	0.054	105.7458	92	92	1994
12	5	5	11	11	0.1191	0.2195	0.6126	0.4686	1.8428	22.66	0.0777	1	0.054	105.7458	91.6	91.6	1994
13	5	5	11	12	0.1249	0.2163	0.5623	0.4299	1.7313	22.66	0.073	1	0.054	105.7458	90.4	90.4	1994
14	5	5	11	13	0.1773	0.2107	0.4377	0.3163	1.1882	22.66	0.0501	1	0.054	105.7458	88.4	88.4	1994
15	5	5	11	14	0.2206	0.2035	0.1009	0.0737	0.9226	22.66	0.0389	1	0.054	105.7458	85.8	85.8	1994
16	5	5	11	15	0.2688	0.1963	0.1009	0.0737	0.7305	22.66	0.0308	1	0.054	105.7458	83.3	83.3	1994
17	5	5	11	16	0.3036	0.1901	0.1009	0.0737	0.6261	22.66	0.0264	1	0.054	105.7458	81	81	1994
18	5	5	11	17	0.4035	0.1857	0.1009	0.0737	0.4601	22.66	0.0194	1	0.054	105.7458	79.4	79.4	1994
19	5	5	11	18	0.5307	0.1813	0.1009	0.0737	0.3415	22.66	0.0144	1	0.054	105.7458	77.8	77.8	1994
20	5	5	11	19	0.6914	0.1771	0.1009	0.0737	0.2561	22.66	0.0108	1	0.054	105.7458	76.3	76.3	1994
21	5	5	11	20	0.8523	0.1738	0.1009	0.0737	0.204	22.66	0.0086	1	0.054	105.7458	75.2	75.2	1994
22	5	5	11	21	0.8917	0.1713	0.1009	0.0737	0.1921	22.66	0.0081	1	0.054	105.7458	74.3	74.3	1994
23	5	5	11	22	0.893	0.1694	0.1009	0.0737	0.1897	22.66	0.008	1	0.054	105.7458	73.6	73.6	1994
24	5	5	11	23	0.723	0.1681	0.1009	0.0737	0.2324	22.66	0.0098	1	0.054	105.7458	73.1	73.1	1994
25	5	5	11	24	0.3773	0.1664	0.1009	0.0737	0.4411	22.66	0.0186	1	0.054	105.7458	72.5	72.5	1994
26	4	5	11	1	0.024	0.0324	0.1486	0.1254	1.3495	22.66	0.0569	1	0.054	105.7458	72	72	1994
27	4	5	11	2	0.0293	0.0513	0.4034	0.3255	1.7551	22.66	0.074	1	0.054	105.7458	72.4	72.4	1994
28	4	5	11	3	0.0458	0.0713	0.4389	0.3389	1.5558	22.66	0.0656	1	0.054	105.7458	74.9	74.9	1994
29	4	5	11	4	0.069	0.0908	0.344	0.2486	1.3163	22.66	0.0555	1	0.054	105.7458	78.9	78.9	1994
30	4	5	11	5	0.1611	0.2063	0.376	0.2733	1.2807	22.66	0.054	1	0.054	105.7458	83	83	1994
31	4	5	11	6	0.1433	0.1979	0.4891	0.34	1.3803	22.66	0.0582	1	0.054	105.7458	86.5	86.5	1994

EXAM 17

Example 17 Data Analysis (Page 1 of 1)



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

Note: Net Present Value (NPV) is a way of comparing the value of money now with the value of money in the future. A dollar today is worth more than a dollar in the future, because inflation erodes the buying power of the future money, while money available today can be invested and grow.

The term constant dollars refers to the net present value relative to a fixed date. The term current dollars refers to the unadjusted value of the money. The term discount rate refers to a percentage used to calculate the NPV, and reflects the time value of money.

For example, assuming a discount rate of 5%, the net present value of $2,000 ten years from now is $1,227.83. So if someone offered you $1,000 now or $2,000 ten years from now, you'd pick the latter because its net present value is higher. (Source: www.investopedia.com)

Here's the calculation:

$$NPV = \text{Future Value}/(1 + \text{Discount Rate})^{\text{years}}$$
$$NPV = \$2000/(1.0 + 0.05)^{10} = \$1,227.83$$

The same approach is applied to emissions.

Example 18 Input File (Page 1 of 1)

```
* Filename: Exam_18.in
* This input is used to generate vehicle lifetime VOC
* and NOx emission rates for a Tier 2 LDGV using the
* DATABASE commands.

***************     Header Section     ***************
MOBILE6 INPUT FILE :

DATABASE OUTPUT    :
DAILY OUTPUT       :
WITH FIELDNAMES    :
POLLUTANTS         : HC NOX
DATABASE VEHICLES  : 21111 11111111 1 111 11111111 111
RUN DATA           :

***************     Run Section     ***************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0  92.0

***************     Scenario Section     ***************
SCENARIO RECORD    : Database Output - 100% LDGV Tier 2
CALENDAR YEAR      : 2050

***************     End of This Run     ***************
END OF RUN         :
```

Example 18 Data Analysis (Page 1 of 1)

Lifetime VOC and NOx Emissions from a Tier 2 LDGV
(Emission Factors Based on MOBILE6 without I/M)

AGE	NHTSA Attrition Curve	Annual Miles	NOx (g/mi)	Exh VOC (g/mi)	Evp VOC (g/mi)	Annual NOx (lb/yr)		Net Present Value	Ann. Exh VOC (lb/yr)		Net Present Value	Ann. Evp VOC (lb/yr)		Net Present Value
						No Attrition	With Attrition		No Attrition	With Attrition		No Attrition	With Attrition	
0	1.000		0.025	0.024	0.128									
1	0.995	14911	0.029	0.026	0.132	0.894	0.891	0.833	0.829	0.827	0.773	4.278	4.266	3.987
2	0.988	14727	0.040	0.033	0.140	1.132	1.122	0.980	0.961	0.953	0.832	4.421	4.384	3.829
3	0.978	14001	0.077	0.059	0.149	1.810	1.780	1.453	1.411	1.387	1.132	4.453	4.378	3.574
4	0.962	13310	0.114	0.084	0.160	2.798	2.714	2.070	2.096	2.033	1.551	4.525	4.388	3.348
5	0.938	12653	0.151	0.109	0.172	3.699	3.514	2.505	2.702	2.567	1.830	4.634	4.402	3.139
6	0.908	12029	0.190	0.135	0.188	4.522	4.174	2.781	3.236	2.987	1.990	4.777	4.410	2.939
7	0.870	11435	0.232	0.161	0.207	5.311	4.721	2.940	3.729	3.315	2.064	4.977	4.424	2.755
8	0.825	10871	0.274	0.188	0.230	6.062	5.138	2.990	4.187	3.548	2.065	5.241	4.441	2.585
9	0.775	10335	0.318	0.215	0.258	6.748	5.398	2.936	4.592	3.673	1.998	5.568	4.455	2.423
10	0.721	9825	0.363	0.242	0.292	7.376	5.515	2.804	4.950	3.701	1.881	5.965	4.460	2.267
11	0.644	9340	0.409	0.270	0.333	7.947	5.422	2.576	5.268	3.594	1.708	6.436	4.391	2.086
12	0.541	8879	0.456	0.298	0.381	8.465	5.017	2.227	5.551	3.290	1.461	6.988	4.141	1.839
13	0.445	8441	0.503	0.326	0.439	8.926	4.400	4.112	5.805	2.861	1.187	7.630	3.761	1.561
14	0.358	8025	0.553	0.356	0.508	9.343	3.751	1.455	6.031	2.421	0.939	8.372	3.361	1.303
15	0.285	7629	0.604	0.386	0.590	9.727	3.127	1.133	6.233	2.003	0.726	9.227	2.966	1.075
16	0.223	7252	0.656	0.416	0.687	10.072	2.557	0.866	6.412	1.628	0.551	10.206	2.591	0.878
17	0.174	6895	0.710	0.448	0.802	10.382	2.060	0.652	6.573	1.304	0.413	11.314	2.245	0.711
18	0.134	6555	0.764	0.481	0.936	10.651	1.638	0.485	6.716	1.033	0.306	12.557	1.931	0.571
19	0.103	6231	0.821	0.515	1.093	10.889	1.290	0.357	6.841	0.810	0.224	13.940	1.651	0.457
20	0.079	5924	0.880	0.550	1.275	11.106	1.008	0.261	6.952	0.631	0.163	15.466	1.404	0.363
21	0.060	5631	0.940	0.586	1.484	11.298	0.783	0.189	7.048	0.488	0.118	17.131	1.187	0.287
22	0.046	5354	1.003	0.623	1.723	11.465	0.605	0.137	7.131	0.376	0.085	18.929	0.999	0.225
23	0.035	5089	1.067	0.661	1.993	11.609	0.465	0.098	7.201	0.289	0.061	20.849	0.836	0.176
24	0.026	4838	1.133	0.700	2.281	11.733	0.357	0.070	7.259	0.221	0.044	22.796	0.693	0.137
				Lifetime Emissions (lbs.):		**184**	**67**	**37**	**120**	**46**	**24**	**231**	**76**	**43**

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

Example 19a Input File (Page 1 of 1)

```
* Filename: Exam_19a.in
* This input generates CY2005 LDGV fleet-average emissions
* under an annual idle I/M program.

******************  Header Section  ************************
MOBILE6 INPUT FILE
RUN DATA

******************  Run Section  ***************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

> Basic I/M Program -- Annual Idle Testing for MY68-MY20
I/M PROGRAM        : 1 1983 2020 1 T/O IDLE
I/M MODEL YEARS    : 1 1968 2020
I/M VEHICLES       : 1 21111 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 95.0
I/M WAIVER RATES   : 1 8.0 8.0
NO I/M TTC CREDITS : 1

******************  Scenario Section  **********************
SCENARIO RECORD    : Summer Basic I/M - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of Run  ****************************
END OF RUN
```

Example 19a Output (Page 1 of 1)

```
*****************************************************************************
* MOBILE6 Draft (17-Aug-2001)                                               *
* Input file: EXAM_19A.IN (file 1, run 1).                                  *
*****************************************************************************
* Basic I/M Program -- Annual Idle Testing for MY68-MY20

* # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Basic I/M - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  72.0 (F)
              Maximum Temperature:  92.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   8.7 psi
                    Weathered RVP:   8.3 psi
              Fuel Sulfur Content:   92. ppm

              Exhaust I/M Program:  Yes
                 Evap I/M Program:  No
                      ATP Program:  No
                 Reformulated Gas:  No
```

Vehicle Type: / GVWR:	LDGV	LDGT12 <6000	LDGT34 >6000	LDGT (All)	HDGV	LDDV	LDDT	HDDV	MC	All Veh
VMT Distribution:	0.4158	0.3387	0.1165		0.0359	0.0006	0.0019	0.0849	0.0057	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.437	1.494	2.315	1.704	2.213	0.578	0.801	0.540	2.46	1.515
Composite CO :	11.97	15.13	19.16	16.16	17.68	1.617	1.408	3.046	16.57	13.328
Composite NOX :	0.932	1.134	1.465	1.219	4.261	1.319	1.371	11.442	1.16	2.076

Example 19b Input File (Page 1 of 1)

```
* Filename: Exam_19b.in
* This input generates CY2005 LDGV fleet-average emissions
* under a biennial 2-mode ASM I/M program using phase-in
* cutpoints.

******************  Header Section  ***********************
MOBILE6 INPUT FILE
RUN DATA

******************  Run Section  **************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

> I/M Program -- Biennial ASM Testing for MY68-MY20
I/M PROGRAM        : 1 1983 2020 2 T/O ASM 2525/5015 PHASE-IN
I/M MODEL YEARS    : 1 1968 2020
I/M VEHICLES       : 1 21111 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 95.0
I/M WAIVER RATES   : 1 8.0 8.0
NO I/M TTC CREDITS : 1

******************  Scenario Section  *********************
SCENARIO RECORD    : Summer Basic I/M - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of Run  ***************************
END OF RUN
```

Example 19b Output (Page 1 of 1)

```
*****************************************************************************
* MOBILE6 Draft (17-Aug-2001)                                               *
* Input file: EXAM_19B.IN (file 1, run 1).                                  *
*****************************************************************************
* I/M Program -- Biennial ASM Testing for MY68-MY20

* Reading ASM I/M Test Credits from ASMDATA.D

* # # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Basic I/M - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # # #
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

                  Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
             Minimum Temperature:  72.0 (F)
             Maximum Temperature:  92.0 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   8.7 psi
                   Weathered RVP:   8.3 psi
             Fuel Sulfur Content:   92. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  No
                     ATP Program:  No
                Reformulated Gas:  No
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4158	0.3387	0.1165		0.0359	0.0006	0.0019	0.0849	0.0057	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.426	1.494	2.315	1.704	2.213	0.578	0.801	0.540	2.46	1.510
Composite CO :	11.67	15.13	19.16	16.16	17.68	1.617	1.408	3.046	16.57	13.202
Composite NOX :	0.847	1.134	1.465	1.219	4.261	1.319	1.371	11.442	1.16	2.041

Example 19c Input File (Page 1 of 1)

```
* Filename: Exam_19c.in
* This input generates CY2005 LDGV fleet-average emissions
* under a program that includes biennial 2-mode ASM using
* phase-in cutpoints for earlier MYs and OBD testing for MY1996+

******************  Header Section  ***********************
MOBILE6 INPUT FILE
RUN DATA

******************  Run Section  **************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

> I/M Program -- Biennial ASM Testing for pre-MY1996
I/M PROGRAM        : 1 1983 2020 2 T/O ASM 2525/5015 PHASE-IN
I/M MODEL YEARS    : 1 1968 1995
I/M VEHICLES       : 1 21111 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 95.0
I/M WAIVER RATES   : 1 8.0 8.0
NO I/M TTC CREDITS : 1

> I/M Program -- Exhaust OBD Testing for MY1996-MY20
I/M PROGRAM        : 2 1983 2020 2 T/O OBD I/M
I/M MODEL YEARS    : 2 1996 2020
I/M VEHICLES       : 2 21111 11111111 1
I/M STRINGENCY     : 2 20.0
I/M COMPLIANCE     : 2 95.0
I/M WAIVER RATES   : 2 8.0 8.0
NO I/M TTC CREDITS : 2

> I/M Program -- Evap OBD Testing for MY1996-MY20
I/M PROGRAM        : 3 1983 2020 2 T/O EVAP OBD
I/M MODEL YEARS    : 3 1996 2020
I/M VEHICLES       : 3 21111 11111111 1
I/M STRINGENCY     : 3 20.0
I/M COMPLIANCE     : 3 95.0
I/M WAIVER RATES   : 3 8.0 8.0
NO I/M TTC CREDITS : 3

******************  Scenario Section  *********************
SCENARIO RECORD    : Summer Basic I/M - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of Run  ***************************
END OF RUN
```

Example 19c Output (Page 1 of 1)

```
*****************************************************************************
* MOBILE6 Draft (31-Aug-2001)                                               *
* Input file: D:\ALLFILES\MOBILE6\DAY4\EXAM_19C.IN (file 1, run 1).         *
*****************************************************************************
* I/M Program -- Biennial ASM Testing for pre-MY1996

* Reading ASM I/M Test Credits from ASMDATA.D
* I/M Program -- Exhaust OBD Testing for MY1996-MY20
* I/M Program -- Evap OBD Testing for MY1996-MY20

* # # # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Basic I/M - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                   Calendar Year:  2005
                           Month:  July
                        Altitude:  Low
              Minimum Temperature:  72.0 (F)
              Maximum Temperature:  92.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   8.7 psi
                    Weathered RVP:   8.3 psi
              Fuel Sulfur Content:   92. ppm

              Exhaust I/M Program:  Yes
                 Evap I/M Program:  Yes
                       ATP Program:  No
                 Reformulated Gas:  No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
              GVWR:                <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 ---------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
    Composite VOC :      1.390     1.494     2.315     1.704     2.213    0.578     0.801     0.540      2.46     1.495
    Composite CO  :     11.42     15.13     19.16     16.16     17.68     1.617     1.408     3.046     16.57    13.097
    Composite NOX :      0.827     1.134     1.465     1.219     4.261    1.319     1.371    11.442      1.16     2.033
 ---------------------------------------------------------------------------------------------------------------------
```

Example 19d Input File (Page 1 of 1)

```
* Filename: Exam_19d.in
* This input generates CY2005 LDGV fleet-average emissions
* under a program that includes biennial 2-mode ASM using
* phase-in cutpoints for earlier MYs and OBD testing for
* 5-year old MY1996+

******************  Header Section  ************************
MOBILE6 INPUT FILE
RUN DATA

******************  Run Section  ***************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

> I/M Program -- Biennial ASM Testing for pre-MY1996
I/M PROGRAM        : 1 1983 2020 2 T/O ASM 2525/5015 PHASE-IN
I/M MODEL YEARS    : 1 1968 1995
I/M VEHICLES       : 1 21111 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 95.0
I/M WAIVER RATES   : 1 8.0 8.0
NO I/M TTC CREDITS : 1

> I/M Program -- Exhaust OBD Testing for MY1996-MY20
I/M PROGRAM        : 2 1983 2020 2 T/O OBD I/M
I/M MODEL YEARS    : 2 1996 2020
I/M GRACE PERIOD   : 2 5
I/M VEHICLES       : 2 21111 11111111 1
I/M STRINGENCY     : 2 20.0
I/M COMPLIANCE     : 2 95.0
I/M WAIVER RATES   : 2 8.0 8.0
NO I/M TTC CREDITS : 2

> I/M Program -- Evap OBD Testing for MY1996-MY20
I/M PROGRAM        : 3 1983 2020 2 T/O EVAP OBD
I/M MODEL YEARS    : 3 1996 2020
I/M GRACE PERIOD   : 3 5
I/M VEHICLES       : 3 21111 11111111 1
I/M STRINGENCY     : 3 20.0
I/M COMPLIANCE     : 3 95.0
I/M WAIVER RATES   : 3 8.0 8.0
NO I/M TTC CREDITS : 3

******************  Scenario Section  **********************
SCENARIO RECORD    : Summer Basic I/M - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of Run  ****************************
END OF RUN
```

Example 19d Output (Page 1 of 1)

```
*********************************************************************
* MOBILE6 Draft (31-Aug-2001)                                       *
* Input file: D:\ALLFILES\MOBILE6\DAY4\EXAM_19D.IN (file 1, run 1).  *
*********************************************************************
* I/M Program -- Biennial ASM Testing for pre-MY1996

* Reading ASM I/M Test Credits from ASMDATA.D
* I/M Program -- Exhaust OBD Testing for MY1996-MY20
* I/M Program -- Evap OBD Testing for MY1996-MY20

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Basic I/M - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
             there are no sales for vehicle class HDGV8b

                  Calendar Year:  2005
                          Month:  July
                       Altitude:  Low
             Minimum Temperature:  72.0 (F)
             Maximum Temperature:  92.0 (F)
               Absolute Humidity:   75. grains/lb
                Nominal Fuel RVP:   8.7 psi
                   Weathered RVP:   8.3 psi
             Fuel Sulfur Content:   92. ppm

             Exhaust I/M Program:  Yes
                Evap I/M Program:  Yes
                     ATP Program:  No
                Reformulated Gas:  No
```

Vehicle Type: / GVWR:	LDGV	LDGT12 <6000	LDGT34 >6000	LDGT (All)	HDGV	LDDV	LDDT	HDDV	MC	All Veh
VMT Distribution:	0.4158	0.3387	0.1165		0.0359	0.0006	0.0019	0.0849	0.0057	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.407	1.494	2.315	1.704	2.213	0.578	0.801	0.540	2.46	1.502
Composite CO :	11.60	15.13	19.16	16.16	17.68	1.617	1.408	3.046	16.57	13.173
Composite NOX :	0.840	1.134	1.465	1.219	4.261	1.319	1.371	11.442	1.16	2.038

Example 19 Input File - Used for Registration Data (Page 1 of 1)

```
* Filename: Exam_19.in
* This input generates CY2005 LDGV fleet-average emissions
* and shows needed vehicle age registration fractions in
* database format.

******************  Header Section  ************************
MOBILE6 INPUT FILE
DATABASE OUTPUT
WITH FIELDNAMES
DAILY OUTPUT
DATABASE VEHICLES  : 21111 11111111 1 111 11111111 111
RUN DATA

******************  Run Section  ***************************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

******************  Scenario Section  **********************
SCENARIO RECORD    : Summer Emissions - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

******************  End of Run  ****************************
END OF RUN
```

Example 19 Data Analysis (Page 1 of 1)

COMPARISON OF I/M PROGRAM TEST COST AND LDGV EMISSIONS

Assume total LDGVs in CY2005 fleet = 1,000,000

Vehicle Age	Model Year	Registration Distribution	Number of Vehicles	Estimated CY2005 Cost			
				Annual Idle	Biennial 2-Mode ASM	ASM & OBD for MY96+	ASM & OBD for MY96+ at 5-yrs
0	2005	0.0531	53100	$ -	$ -	$ -	-
1	2004	0.0707	70700	$ 848,400	$ 707,000	$ 494,900	-
2	2003	0.0707	70700	$ 848,400	$ 707,000	$ 494,900	-
3	2002	0.0706	70600	$ 847,200	$ 706,000	$ 494,200	-
4	2001	0.0704	70400	$ 844,800	$ 704,000	$ 492,800	-
5	2000	0.0699	69900	$ 838,800	$ 699,000	$ 489,300	$ 489,300
6	1999	0.069	69000	$ 828,000	$ 690,000	$ 483,000	$ 483,000
7	1998	0.0677	67700	$ 812,400	$ 677,000	$ 473,900	$ 473,900
8	1997	0.0656	65600	$ 787,200	$ 656,000	$ 459,200	$ 459,200
9	1996	0.0628	62800	$ 753,600	$ 628,000	$ 439,600	$ 439,600
10	1995	0.0589	58900	$ 706,800	$ 589,000	$ 589,000	$ 589,000
11	1994	0.054	54000	$ 648,000	$ 540,000	$ 540,000	$ 540,000
12	1993	0.0459	45900	$ 550,800	$ 459,000	$ 459,000	$ 459,000
13	1992	0.0363	36300	$ 435,600	$ 363,000	$ 363,000	$ 363,000
14	1991	0.0288	28800	$ 345,600	$ 288,000	$ 288,000	$ 288,000
15	1990	0.0228	22800	$ 273,600	$ 228,000	$ 228,000	$ 228,000
16	1989	0.0181	18100	$ 217,200	$ 181,000	$ 181,000	$ 181,000
17	1988	0.0144	14400	$ 172,800	$ 144,000	$ 144,000	$ 144,000
18	1987	0.0114	11400	$ 136,800	$ 114,000	$ 114,000	$ 114,000
19	1986	0.009	9000	$ 108,000	$ 90,000	$ 90,000	$ 90,000
20	1985	0.0071	7100	$ 85,200	$ 71,000	$ 71,000	$ 71,000
21	1984	0.0056	5600	$ 67,200	$ 56,000	$ 56,000	$ 56,000
22	1983	0.0044	4400	$ 52,800	$ 44,000	$ 44,000	$ 44,000
23	1982	0.0034	3400	$ 40,800	$ 34,000	$ 34,000	$ 34,000
24	1981	0.0096	9600	$ 115,200	$ 96,000	$ 96,000	$ 96,000
TOTAL CY2005 COST				**$ 11,365,200**	**$ 9,471,000**	**$ 7,618,800**	**$ 5,642,000**
FLEET VOC EMISSIONS (g/mi) =				1.437	1.426	1.390	1.407
FLEET CO EMISSIONS (g/mi) =				11.97	11.67	11.42	11.60
FLEET NOx EMISSIONS (g/mi) =				0.932	0.847	0.827	0.840

Issues to Consider:

a. The above cost estimates do not include repair costs. The ASM and ASM+OBD programs would have higher repair costs because more vehicles would be failed.

b. The above cost estimates also do not include retest costs. The ASM and ASM+OBD programs would have higher retest costs because more vehicles would be failed.

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
RVP: 8.7 psi (9.0 psi limit)
RVP: 6.9 psi (7.0 psi limit)
Evaluation month: July

Example 20 Input File (Page 1 of 1)

```
* Filename: Exam_20.in
* This input generates the summer fleet-average VOC, CO and NOx
* emissions for calendar year 2005 when maximum RVP is set to
* 9.0 and 7.0 psi.  The 9.0 psi case assumes 8.7 psi in-use;
* The 7.0 psi case assumes 6.9 psi in-use.

******************  Header Section  ************************
MOBILE6 INPUT FILE :

RUN DATA           :
******************  Scenario Section #1  *******************
SCENARIO RECORD    : CY2005 -- 8.7 psi RVP In-Use
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

******************  Scenario Section #2 ********************
SCENARIO RECORD    : CY2005 -- 6.9 psi RVP In-Use
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
FUEL RVP           : 6.9
MIN/MAX TEMP       : 72.0 92.0

******************  End of This Run  ***********************
END OF RUN         :
```

Example 20 Output (Page 1 of 1)

```
*******************************************************************************
* MOBILE6 Draft (31-Aug-2001)                                                 *
* Input file: D:\ALLFILES\MOBILE6\DAY4\EXAM_20.IN (file 1, run 1).            *
*******************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* CY2005 -- 8.7 psi RVP In-Use
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                     Calendar Year:  2005
                             Month:  July
                          Altitude:  Low
               Minimum Temperature:  72.0 (F)
               Maximum Temperature:  92.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   8.7 psi
                     Weathered RVP:   8.3 psi
               Fuel Sulfur Content:   92. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                 <6000     >6000     (All)
                     ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :      1.500     1.494     2.315     1.704     2.213     0.578     0.801     0.540      2.46     1.541
    Composite CO  :     13.11     15.13     19.16     16.16     17.68     1.617     1.408     3.046     16.57    13.799
    Composite NOX :      0.947     1.134     1.465     1.219     4.261     1.319     1.371    11.442      1.16     2.083
 -------------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* CY2005 -- 6.9 psi RVP In-Use
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                     Calendar Year:  2005
                             Month:  July
                          Altitude:  Low
               Minimum Temperature:  72.0 (F)
               Maximum Temperature:  92.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   6.9 psi
                     Weathered RVP:   6.6 psi
               Fuel Sulfur Content:   92. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                 <6000     >6000     (All)
                     ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
 -------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :      1.142     1.228     1.904     1.401     1.681     0.578     0.801     0.540      2.12     1.233
    Composite CO  :     12.88     14.82     18.66     15.80     17.05     1.617     1.408     3.046     16.57    13.519
    Composite NOX :      0.936     1.122     1.451     1.206     4.343     1.319     1.371    11.442      1.16     2.075
 -------------------------------------------------------------------------------------------------------------------------
```

Example 20 Data Analysis (Page 1 of 1)

Summary Table for Example 20 -- Lowering RVP from 8.7 to 6.9 psi

Max RVP (psi)	Fleet Emissions (g/mi)		
	VOC	CO	NOx
9.0	1.541	13.799	2.083
7.0	1.233	13.519	2.075
Difference (g/mi)	0.308	0.28	0.008
Basis = 1,000,000 Daily Vehicle Miles Traveled			
Emissions Benefits (tons)	0.34	0.31	0.01

Total Gallons of Gasoline Used for 1,000,000 Daily Fleet Miles =		48,944
Total Daily Cost for Lowering Max RVP from 9.0 to 7.0 =	$	1,223.60

Cost Effectiveness of Measure:	**VOC**	**$**	**3,604**	**/ton**
	CO	**$**	**3,964**	**/ton**
	NOx	**$**	**138,756**	**/ton**

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 21 Input File (Page 1 of 1)

```
* Filename: Exam_21.in
* This input generates the summer fleet-average VOC, CO and NOx
* emissions for calendar year 2005 with a modified NLEV implementation
* schedule reflecting the Northeast phsse-in.

********************  Header Section  ************************
MOBILE6 INPUT FILE :
RUN DATA           :

********************  Run Section #1  ************************
* This run uses the modified alternative schedule for MY1994+
* LDGV standards.

FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

* Use NLEV phase-in fractions from external file
94+ LDG IMP        : p94imp.x21

********************  Scenario Section  **********************
SCENARIO RECORD    : Summer Fleet-Average Emission - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

********************  End of Run #1  *************************
END OF RUN

********************  Run Section #2  ************************
* This run shows the default MOBILE6 emissions estimates
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0 92.0

********************  Scenario Section  **********************
SCENARIO RECORD    : Summer Fleet-Average Emission - CY2005
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7

********************  End of Run #2 *************************
END OF RUN
```

Example 21 File Input : p94imp.x21 (Sample Page)

```
* Filename: p94imp.x21 from modified p94imp.d file

* This is now a standard Mobile6 external data file.
* The header 94+ LDG IMPLEMENTATION is now required.
* Comments and blank lines are allowed in the header
* and between the blocks of data.

* this phase-in schedule reflects MOBILE6 default for
* Tier 1, NLEV (non-OTC), and Tier 2

94+ LDG IMPLEMENTATION

* The data is divided into 5 blocks, one each for LDGV, LDGT1, LDGT2,
* LDGT3, and LDGT4. In each data block there is one data line for each
* calendar year from 1994 to 2025. Each line contains the phase-in
* values for that year for 11 different vehicle standards categories.
* The first column is Tier0   the second is intermediate Tier1, the third
* is Tier1, and the fourth column is Tier2. The remaining columns are
* intermediate TLEV, TLEV, intermediate LEV, LEV, intermediate ULEV, ULEV,
* and ZEV. These are the standards categories defined by the California
* LEV program.

* 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
  0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.0   0.4   0.0   0.0   0.0   0.0   0.6   0.0   0.0   0.0
  0.0   0.0   0.1   0.0   0.0   0.0   0.0   0.9   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0

* LDGT1
  0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.6   0.4   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.2   0.8   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.0   1.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  0.0   0.0   0.4   0.0   0.0   0.0   0.0   0.6   0.0   0.0   0.0
  0.0   0.0   0.1   0.0   0.0   0.0   0.0   0.9   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   1.0   0.0   0.0   0.0
```

Example 21 Output (Page 1 of 1)

```
*******************************************************************************
* MOBILE6 Draft (31-Aug-2001)                                                 *
* Input file: EXAM_21.IN (file 1, run 1).                                     *
*******************************************************************************

* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: P94IMP.X21

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Fleet-Average Emission - CY2005
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file P94IMP.X21
                     Calendar Year:  2005
                             Month:  July
                          Altitude:  Low
              Minimum Temperature:  72.0 (F)
              Maximum Temperature:  92.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   8.7 psi
                    Weathered RVP:   8.3 psi
              Fuel Sulfur Content:   92. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  No
                 Reformulated Gas:  No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT       HDGV      LDDV      LDDT      HDDV        MC   All Veh
              GVWR:                <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
  ---------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.478     1.464     2.315     1.682     2.213    0.562     0.801     0.540      2.46     1.522
     Composite CO  :     13.67     15.55     19.16     16.47     17.68    1.617     1.408     3.046     16.57    14.177
     Composite NOX :      0.940     1.102     1.465     1.195     4.261    1.246     1.371    11.442      1.16     2.069
  ---------------------------------------------------------------------------------------------------------------------
*******************************************************************************
* MOBILE6 Draft (31-Aug-2001)                                                 *
* Input file: EXAM_21.IN (file 1, run 2).                                     *
*******************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Summer Fleet-Average Emission - CY2005
* File 1, Run 2, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                     Calendar Year:  2005
                             Month:  July
                          Altitude:  Low
              Minimum Temperature:  72.0 (F)
              Maximum Temperature:  92.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   8.7 psi
                    Weathered RVP:   8.3 psi
              Fuel Sulfur Content:   92. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  No
                 Reformulated Gas:  No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT       HDGV      LDDV      LDDT      HDDV        MC   All Veh
              GVWR:                <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:    0.4158    0.3387    0.1165              0.0359    0.0006    0.0019    0.0849    0.0057    1.0000
  ---------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      1.500     1.494     2.315     1.704     2.213    0.578     0.801     0.540      2.46     1.541
     Composite CO  :     13.11     15.13     19.16     16.16     17.68    1.617     1.408     3.046     16.57    13.799
     Composite NOX :      0.947     1.134     1.465     1.219     4.261    1.319     1.371    11.442      1.16     2.083
  ---------------------------------------------------------------------------------------------------------------------
```

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 22 Input File

```
* Filename: Exam_22.in
* This input is used to generate vehicle lifetime VOC
* and NOx emission rates for an NLEV LDGV using the
* DATABASE commands.

***************     Header Section     ***************
MOBILE6 INPUT FILE :

DATABASE OUTPUT    :
DAILY OUTPUT       :
WITH FIELDNAMES    :
POLLUTANTS         : HC NOX
DATABASE VEHICLES  : 21111 11111111 1 111 11111111 111

RUN DATA           :
***************     Run Section     ***************
FUEL RVP           : 8.7
MIN/MAX TEMP       : 72.0  92.0

* Disable the impacts of Tier 2 (vehicle and fuel)
NO TIER2           :

***************     Scenario Section     ***************
SCENARIO RECORD    : Database Output - 100% LDGV NLEVs
CALENDAR YEAR      : 2050

***************     End of This Run     ***************
END OF RUN         :
```

Example 22 - Lifetime Emissions (from *.TB1 file)

Lifetime VOC and NOx Emissions from an NLEV LDGV
(Emission Factors Based on MOBILE6 without I/M)

AGE	NHTSA Attrition Curve	Annual Miles	NOx (g/mi)	Exh VOC (g/mi)	Evp VOC (g/mi)	Annual NOx (lb/yr)		Net Present Value	Ann. Exh VOC (lb/yr)		Net Present Value	Ann. Evp VOC (lb/yr)		Net Present Value
						No Attrition	With Attrition		No Attrition	With Attrition		No Attrition	With Attrition	
0	1.000		0.311	0.079	0.147									
1	0.995	14911	0.364	0.088	0.152	11.096	11.066	10.342	2.738	2.730	2.552	4.927	4.914	4.592
2	0.988	14727	0.459	0.106	0.161	13.375	13.261	11.583	3.153	3.126	2.730	5.085	5.042	4.404
3	0.978	14001	0.605	0.143	0.171	16.425	16.148	13.182	3.852	3.787	3.091	5.117	5.031	4.107
4	0.962	13310	0.746	0.180	0.183	19.816	19.217	14.661	4.740	4.597	3.507	5.191	5.034	3.840
5	0.938	12653	0.883	0.215	0.197	22.715	21.581	15.387	5.508	5.233	3.731	5.297	5.033	3.588
6	0.908	12029	1.016	0.250	0.213	25.177	23.243	15.488	6.164	5.691	3.792	5.438	5.020	3.345
7	0.870	11435	1.152	0.286	0.234	27.325	24.288	15.125	6.750	6.000	3.736	5.637	5.011	3.121
8	0.825	10871	1.283	0.321	0.258	29.178	24.728	14.392	7.271	6.162	3.586	5.899	5.000	2.910
9	0.775	10335	1.413	0.356	0.288	30.716	24.572	13.365	7.717	6.173	3.358	6.225	4.980	2.709
10	0.721	9825	1.539	0.391	0.323	31.971	23.905	12.152	8.097	6.054	3.078	6.621	4.950	2.517
11	0.644	9340	1.662	0.427	0.365	32.961	22.488	10.684	8.421	5.746	2.730	7.090	4.837	2.298
12	0.541	8879	1.784	0.462	0.415	33.733	19.991	8.876	8.698	5.155	2.289	7.637	4.526	2.010
13	0.445	8441	1.902	0.498	0.474	34.303	16.909	15.802	8.935	4.404	1.828	8.274	4.078	1.692
14	0.358	8025	2.021	0.535	0.545	34.707	13.934	5.404	9.134	3.667	1.422	9.012	3.618	1.403
15	0.285	7629	2.139	0.572	0.628	34.987	11.246	4.076	9.303	2.991	1.084	9.862	3.170	1.149
16	0.223	7252	2.257	0.610	0.727	35.144	8.923	3.023	9.447	2.399	0.812	10.833	2.750	0.932
17	0.174	6895	2.374	0.649	0.843	35.195	6.984	2.211	9.566	1.898	0.601	11.933	2.368	0.750
18	0.134	6555	2.489	0.689	0.979	35.136	5.404	1.599	9.662	1.486	0.440	13.169	2.025	0.599
19	0.103	6231	2.606	0.729	1.138	34.996	4.145	1.146	9.739	1.153	0.319	14.543	1.722	0.476
20	0.079	5924	2.724	0.771	1.321	34.807	3.159	0.816	9.799	0.889	0.230	16.056	1.457	0.377
21	0.060	5631	2.843	0.814	1.532	34.560	2.395	0.578	9.842	0.682	0.165	17.707	1.227	0.296
22	0.046	5354	2.963	0.858	1.771	34.263	1.808	0.408	9.871	0.521	0.118	19.490	1.028	0.232
23	0.035	5089	3.084	0.904	2.042	33.923	1.360	0.287	9.885	0.396	0.084	21.393	0.857	0.181
24	0.026	4838	3.207	0.950	2.331	33.551	1.020	0.201	9.888	0.301	0.059	23.320	0.709	0.140
			Lifetime Emissions (lbs.):			**710**	**322**	**191**	**188**	**81**	**45**	**246**	**84**	**48**

Example 22 - Lifetime Fuel Usage

Estimated Lifetime Fuel Usage and Cost Differential for Tier 2 Fuel

AGE	NHTSA Attrition Curve	Annual Miles	Fuel Economy (mpg)	Annual Fuel Use (gal)		Net Present Value
				No Attrition	With Attrition	
0	1.000		22.6			
1	0.995	14911	22.6	659	657	614
2	0.988	14727	22.6	651	645	563
3	0.978	14001	22.6	618	608	496
4	0.962	13310	22.6	588	570	435
5	0.938	12653	22.6	559	531	379
6	0.908	12029	22.6	531	490	327
7	0.870	11435	22.6	505	449	280
8	0.825	10871	22.6	480	407	237
9	0.775	10335	22.6	456	365	199
10	0.721	9825	22.6	434	324	165
11	0.644	9340	22.6	413	281	134
12	0.541	8879	22.6	392	232	103
13	0.445	8441	22.6	373	184	76
14	0.358	8025	22.6	354	142	55
15	0.285	7629	22.6	337	108	39
16	0.223	7252	22.6	320	81	28
17	0.174	6895	22.6	305	60	19
18	0.134	6555	22.6	290	45	13
19	0.103	6231	22.6	275	33	9
20	0.079	5924	22.6	262	24	6
21	0.060	5631	22.6	249	17	4
22	0.046	5354	22.6	236	12	3
23	0.035	5089	22.6	225	9	2
24	0.026	4838	22.6	214	6	1
			Lifetime Fuel Use (gal):	**9725**	**6283**	**4187**
			Lifetime Fuel Cost Differential (@2 cents/gal):			**$ 83.73**

Example 22 - Emissions and Cost Summary

NPV of LDGV Lifetime Emissions

Standard	NOx (lbs.)	Exhaust VOC (lbs.)	Evap VOC (lbs.)
Tier 2 LDGV	37	24	43
NLEV LDGV	191	45	48
Tier 2 Benefit	154	21	5

NPV of Tier 2 Costs for LDGVs:

Hardware	$100
Fuel	$84
Total	$184

Tier 2 Cost Effectiveness for LDGVs:

NOx	$2,390
VOC	$14,154
VOC + NOx	$2,044

Note: This assumes a non-I/M, non-RFG case. If I/M and/or RFG had been applied, the benefits (and therefore cost-effectiveness). would be different.

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

Example 23 - Emissions and Cost Summary

NPV of LDGV Lifetime Emissions

(See Examples 18 and 22)

Standard	NOx (lbs.)	Exhaust VOC (lbs.)	Evap VOC (lbs.)
Tier 2 LDGV	37	24	43
NLEV LDGV	191	45	48

23a. Evaporative lifetime emissions of a Tier 2 LDGV: 43 lbs.

Cost-effectiveness of an NGV if only benefit is in terms of evaporative emissions is then (assuming $2,000 cost differential):

CE = Cost/Benefit = $2,000 / (43/2000) = $93,000 per ton VOC reduced.

23b. Cost-effectiveness of a ZEV relative to a Tier 2 vehicle:

Total NOx + VOC lifetime emissions from a Tier 2 vehicle = 104 lbs.

CE = Cost/Benefit = $21,000 / (104/2000) = $400,000 per ton NOx+VOC reduced.

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

Example 24 Input File

```
* Filename: Exam_24.in
* This input file generates emission factors for a case in
* which 10% of the new 1998 to 2003 MY LDGVs were natural
* gas vehicles

*********************   Header Section   ************************
MOBILE6 INPUT FILE :

RUN DATA           :
*********************   Run Section   ***************************
MIN/MAX TEMP       : 72. 92.
FUEL RVP           : 8.7

* Specify natural gas vehicle fractions
NGV FRACTION       : NGVFR.X24

*********************   Scenario Section   **********************
SCENARIO RECORD    : 10% NGVs from 1998 to 2003 MY
CALENDAR YEAR      : 2005

*********************   End of this Run   ***********************
END OF RUN


*********************   Run Section   ***************************
MIN/MAX TEMP       : 72. 92.
FUEL RVP           : 8.7

*********************   Scenario Section   **********************
SCENARIO RECORD    : Baseline Run
CALENDAR YEAR      : 2005

*********************   End of this Run   ***********************
END OF RUN
```

Modified Natural Gas Vehicle Fraction File (NGVFR.X24)

```
NGV FRACTION
* Comments and blank lines are allowed in the header
* and between the blocks of data.
*
*  The data is divided into 28 blocks, one each for the vehicle types.
*  In each data block there is one data entry for each
*  calendar year from 1994 to 2050. Each entry contains the NGV phase-in
*  values for that year.

* Vehicle Type #1 (LDGV)  -  NGV Phase-in 1994-2050
000.0000 000.0000 000.0000 000.0000 010.0000 010.0000 010.0000 010.0000
010.0000 010.0000 000.0000 000.0000 000.0000 000.0000 000.0000 000.0000
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* Vehicle Type #2 (LDGT1)  -  NGV Phase-in 1994-2050
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* Vehicle Type #3 (LDGT2)  -  NGV Phase-in 1994-2050
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* Vehicle Type #4 (LDGT3)  -  NGV Phase-in 1994-2050
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000.0000

etc...
```

Example 24 Output File

```
*********************************************************************
* MOBILE6 Draft (31-Aug-2001)                                       *
* Input file: EXAM_24.IN (file 1, run 1).                           *
*********************************************************************

* Reading NGV IMPLEMENTATION SCHEDULE from the following external
* data file: NGVFR.X24

  Reading User Supplied NGV phase-in fractions

* # # # # # # # # # # # # # # # # # # # # # # #
* 10% NGVs from 1998 to 2003 MY
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  Jan.
                         Altitude:  Low
               Minimum Temperature:  72.0 (F)
               Maximum Temperature:  92.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   8.7 psi
                     Weathered RVP:   8.3 psi
               Fuel Sulfur Content:   92. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4225    0.3349    0.1143              0.0357    0.0006    0.0018    0.0844    0.0057    1.0000
 -----------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
    Composite VOC :      1.495     1.515     2.387     1.737     2.307    0.582     0.820     0.558      2.53     1.558
    Composite CO  :     12.72     14.97     19.66     16.16     18.07     1.610     1.437     3.114     16.74    13.643
    Composite NOX :      0.942     1.129     1.494     1.222     4.499    1.350     1.430    11.938      1.16     2.125
 -----------------------------------------------------------------------------------------------------------------------
.
*********************************************************************
* MOBILE6 Draft (31-Aug-2001)                                       *
* Input file: EXAM_24.IN (file 1, run 2).                           *
*********************************************************************

* # # # # # # # # # # # # # # # # # # # # # # #
* Baseline Run
* File 1, Run 2, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # #
  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                    Calendar Year:  2005
                            Month:  Jan.
                         Altitude:  Low
               Minimum Temperature:  72.0 (F)
               Maximum Temperature:  92.0 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   8.7 psi
                     Weathered RVP:   8.3 psi
               Fuel Sulfur Content:   92. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  No
                  Reformulated Gas:  No

      Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
             GVWR:                <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
  VMT Distribution:    0.4225    0.3349    0.1143              0.0357    0.0006    0.0018    0.0844    0.0057    1.0000
 -----------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
    Composite VOC :      1.519     1.515     2.387     1.737     2.307    0.582     0.820     0.558      2.53     1.568
    Composite CO  :     13.11     14.97     19.66     16.16     18.07     1.610     1.437     3.114     16.74    13.806
    Composite NOX :      0.958     1.129     1.494     1.222     4.499    1.350     1.430    11.938      1.16     2.132
 -----------------------------------------------------------------------------------------------------------------------
```

Example 24 Summary

	VOC	CO	NOx
CY 2005 Fleet-Average Emissions with NGVs (g/mi):	1.558	13.643	2.125
CY 2005 Fleet-Average Emissions without NGVs (g/mi):	1.568	13.806	2.132

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

Example 25 – LDGV VOC, CO, NOx

LDGV Emission Rates				g/mi Emission Factors		
MYR	MILES	REGDIST	Tr Frac	VOC	CO	NOx
1981	12.3	0.0096	0.0040	11.60	69.58	3.29
1982	12.9	0.0034	0.0015	11.21	68.61	3.24
1983	13.6	0.0044	0.0020	10.38	49.38	3.15
1984	14.3	0.0056	0.0027	9.85	46.23	3.08
1985	15.0	0.0071	0.0037	9.34	42.65	3.00
1986	15.8	0.0090	0.0049	8.12	35.95	2.74
1987	16.6	0.0114	0.0065	7.59	33.97	2.69
1988	17.5	0.0144	0.0086	6.46	24.34	2.37
1989	18.4	0.0181	0.0114	5.96	24.53	2.26
1990	19.4	0.0228	0.0151	5.34	23.36	2.19
1991	20.4	0.0288	0.0201	4.72	22.26	2.11
1992	21.4	0.0363	0.0267	4.18	21.97	2.01
1993	22.5	0.0459	0.0355	3.63	21.04	1.92
1994	23.7	0.0540	0.0439	3.09	19.44	1.64
1995	24.9	0.0589	0.0504	2.60	17.32	1.37
1996	26.2	0.0628	0.0565	1.66	15.81	1.20
1997	27.6	0.0656	0.0621	1.32	14.74	1.12
1998	29.0	0.0677	0.0674	0.93	13.66	1.03
1999	30.5	0.0690	0.0722	0.73	12.41	0.93
2000	32.1	0.0699	0.0770	0.62	11.06	0.83
2001	33.8	0.0704	0.0815	0.38	12.72	0.62
2002	35.6	0.0706	0.0860	0.32	9.62	0.47
2003	37.4	0.0707	0.0906	0.26	6.28	0.33
2004	39.3	0.0707	0.0953	0.22	4.51	0.21
2005	40.9	0.0531	0.0743	0.20	3.53	0.11
			Fleet-Ave Emissions:	1.498	13.115	0.946

Example 25 – 8B HDDV NOx Emissions

HDDV NOx Emission Rates

MYR	MILES	REGDIST	Trv Frac	G/MI
2005	340	0.039	0.079	6.46
2004	324	0.073	0.141	6.55
2003	294	0.068	0.119	7.54
2002	267	0.064	0.101	11.08
2001	242	0.059	0.086	15.98
2000	219	0.056	0.073	16.06
1999	199	0.052	0.062	16.13
1998	180	0.049	0.052	18.56
1997	163	0.046	0.044	20.09
1996	148	0.043	0.038	19.92
1995	134	0.040	0.032	20.55
1994	122	0.037	0.027	20.57
1993	110	0.035	0.023	28.70
1992	100	0.033	0.019	29.99
1991	91	0.030	0.016	24.31
1990	82	0.029	0.014	22.70
1989	74	0.027	0.012	28.13
1988	67	0.025	0.010	27.36
1987	61	0.023	0.009	26.48
1986	55	0.022	0.007	26.48
1985	50	0.020	0.006	26.55
1984	46	0.019	0.005	26.58
1983	41	0.018	0.004	26.65
1982	37	0.017	0.004	26.67
1981	34	0.080	0.016	27.54

Fleet-Ave Emission Rate: 14.76

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.

Example 26 Results

LDGV Emission Rates

MYR	Age	MILES	Baseline REGDIST	Tr Frac	Scrap REGDIST	Norm REGDIST	Revised Trv Frac	g/mi Emission Factors VOC	CO	NOx
1981	24	12.3	0.0096	0.0040	0.0091	0.0092	0.0039	11.60	69.58	3.29
1982	23	12.9	0.0034	0.0015	0.0032	0.0032	0.0014	11.21	68.61	3.24
1983	22	13.6	0.0044	0.0020	0.0042	0.0042	0.0020	10.38	49.38	3.15
1984	21	14.3	0.0056	0.0027	0.0053	0.0053	0.0026	9.85	46.23	3.08
1985	20	15.0	0.0071	0.0037	0.0067	0.0068	0.0035	9.34	42.65	3.00
1986	19	15.8	0.0090	0.0049	0.0086	0.0086	0.0047	8.12	35.95	2.74
1987	18	16.6	0.0114	0.0065	0.0108	0.0109	0.0062	7.59	33.97	2.69
1988	17	17.5	0.0144	0.0086	0.0137	0.0137	0.0082	6.46	24.34	2.37
1989	16	18.4	0.0181	0.0114	0.0172	0.0173	0.0109	5.96	24.53	2.26
1990	15	19.4	0.0228	0.0151	0.0217	0.0218	0.0144	5.34	23.36	2.19
1991	14	20.4	0.0288	0.0201	0.0288	0.0289	0.0202	4.72	22.26	2.11
1992	13	21.4	0.0363	0.0267	0.0363	0.0365	0.0267	4.18	21.97	2.01
1993	12	22.5	0.0459	0.0355	0.0459	0.0461	0.0356	3.63	21.04	1.92
1994	11	23.7	0.0540	0.0439	0.0540	0.0543	0.0440	3.09	19.44	1.64
1995	10	24.9	0.0589	0.0504	0.0589	0.0592	0.0505	2.60	17.32	1.37
1996	9	26.2	0.0628	0.0565	0.0628	0.0631	0.0567	1.66	15.81	1.20
1997	8	27.6	0.0656	0.0621	0.0656	0.0659	0.0623	1.32	14.74	1.12
1998	7	29.0	0.0677	0.0674	0.0677	0.0680	0.0676	0.93	13.66	1.03
1999	6	30.5	0.0690	0.0722	0.0690	0.0694	0.0724	0.73	12.41	0.93
2000	5	32.1	0.0699	0.0770	0.0699	0.0703	0.0772	0.62	11.06	0.83
2001	4	33.8	0.0704	0.0815	0.0704	0.0708	0.0818	0.38	12.72	0.62
2002	3	35.6	0.0706	0.0860	0.0706	0.0710	0.0863	0.32	9.62	0.47
2003	2	37.4	0.0707	0.0906	0.0707	0.0711	0.0909	0.26	6.28	0.33
2004	1	39.3	0.0707	0.0953	0.0707	0.0711	0.0956	0.22	4.51	0.21
2005	0	40.9	0.0531	0.0743	0.0531	0.0534	0.0746	0.20	3.53	0.11
							Baseline Fleet-Ave Emissions:	1.498	13.115	0.946
							Fleet-Ave With Scrappage:	1.481	13.054	0.942
							Reductions From Scrappage:	1.2%	0.5%	0.5%

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%.

Example 27 Results

HDDV NOx Emission Rates

MYR	MILES	REGDIST	Trv Frac	G/MI	Rebuild g/mi	20% Rebui g/mi
2005	340	0.039	0.079	6.46	6.46	6.46
2004	324	0.073	0.141	6.55	6.55	6.55
2003	294	0.068	0.119	7.54	7.54	7.54
2002	267	0.064	0.101	11.08	11.08	11.08
2001	242	0.059	0.086	15.98	15.98	15.98
2000	219	0.056	0.073	16.06	16.06	16.06
1999	199	0.052	0.062	16.13	16.13	16.13
1998	180	0.049	0.052	18.56	18.56	18.56
1997	163	0.046	0.044	20.09	8.04	17.68
1996	148	0.043	0.038	19.92	7.97	17.53
1995	134	0.040	0.032	20.55	8.22	18.08
1994	122	0.037	0.027	20.57	8.23	18.10
1993	110	0.035	0.023	28.70	11.48	25.26
1992	100	0.033	0.019	29.99	11.99	26.39
1991	91	0.030	0.016	24.31	9.72	21.39
1990	82	0.029	0.014	22.70	9.08	19.98
1989	74	0.027	0.012	28.13	28.13	28.13
1988	67	0.025	0.010	27.36	27.36	27.36
1987	61	0.023	0.009	26.48	26.48	26.48
1986	55	0.022	0.007	26.48	26.48	26.48
1985	50	0.020	0.006	26.55	26.55	26.55
1984	46	0.019	0.005	26.58	26.58	26.58
1983	41	0.018	0.004	26.65	26.65	26.65
1982	37	0.017	0.004	26.67	26.67	26.67
1981	34	0.080	0.016	27.54	27.54	27.54

Baseline Fleet-Ave Emission Rate: 14.76

Rebuild Emission Rate: 14.18

Reduction from Rebuild Program: 3.9%