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"Implementation simulation model to estimate traffic emission"

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Abstract.

Traffic sector presents a major contributor to air pollution in Palestine. This causes high emissions emitted from vehicles, such as carbon monoxide (CO), nitrogen oxides (NOx), particulate matters (PM), volatile organic compounds (VOCs) and sulphur dioxide (SO2).

This work concentrates in making a simulation model to estimate traffic emission by using MOBILE6.

MOBILE6 is a computer program that estimates emission factors for gasoline-fueled and diesel motor vehicles, and for certain specialized vehicles such as natural-gas-fueled or electric vehicles that may replace them.

This model calculates emission factors for 28 individual vehicles. Depend on various conditions, such as ambient temperatures, travel speeds, age distribution, fuel volatility, and mileage accrual rates. This model will estimate emission factors for any calendar year between 2002 and 2050, inclusive. Vehicles from the 25 most recent model years are considered to be in operation in each calendar year.

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Abbreviation

VMT - Vehicle miles traveled

VOC - Volatile organic compound: reactive HC emissions

THC - Total Hydrocarbons

TOG - Total Organic Gases

RFG - Reformulated Gasoline

RVP - Reid Vapor Pressure; a measure of gasoline volatility

ppm - parts per million: the units normally used to express ambient CO concentrations and fuel sulfur levels.

$PM_{2.5}$ - Particulates with diameter of 2.5 microns or less. PM_{10} - Particulates with diameter of 10 microns or less.

NOx - Oxides of nitrogen

LDDT - Light-Duty Diesel Truck

LDDV - Light-Duty Diesel Vehicle

LDGT - Light-Duty Gasoline Truck

LDGV - Light-Duty Gasoline Vehicle

LDT - Light-Duty Truck; a light truck rated at 8,500 lbs. GVWR or less.

LDT1 - An LDT with a GVWR # 6,000 lbs. and an LVW # 3,750 lbs.

LDT2 - An LDT with a GVWR # 6,000 lbs. and an LVW from 3,751 to 5,750 lbs.

LDT3 - An LDT with a GVWR from 6,001 - 8,500 lbs. and an
LVW # 3,750 lbs.

LDT4 - An LDT with a GVWR from 6,001 - 8,500 lbs. and an
LVW from 3,751 to 5,750 lbs.

LDV - Light-Duty Vehicle; a passenger car or passenger car derivative seating 12 passengers or less.

LEV - Low-Emission Vehicle

LLDT - Light Light-Duty Truck; any light-duty truck with a GVWR up through 6,000 lbs.

LVW - Loaded Vehicle Weight; used for certification purposes, LVW is the curb weight of the vehicle plus 300 lbs.

MC - Motorcycles

I/M Program - Vehicle emissions inspection and maintenance program.

g/mi - Grams per mile: a unit of emissions measurement when testing is conducted on a chassis dynamometer.

GVWR - Gross Vehicle Weight Rating

HC - Hydrocarbons

HDDV - Heavy-Duty Diesel Vehicle

HDGV - Heavy-Duty Gasoline Vehicle

HDV - Heavy-Duty Vehicle

ECOS - Environmental Council of the States

EF - Emission factor

EGR - Exhaust Gas Recirculation

CO - Carbon monoxide

LRTP - Long Range transportation Plane

TIP - Transportation Improvement Program.

SO_2-sulfur dioxide

NO_x-Nitrogen oxides

SI- spark ignition engine

ICE- internal combustion engine

O_3. the molecular formula for ozone

NO- Nitric oxide

N_2. Nitrogen

N_2O- Nitrous oxide

NO_2. nitrogen dioxide

CO_2 - carbon dioxide

EPA - Environmental Protection Agency

LVWR - Alternative Loaded Vehicle Weight

ASCII - American Standard Code for Information Interchange

REG DIST – registration distribution

MOVWES - Motor Vehicle Emission Simulator

Chapter one
Basic information

1.1. Introduction

An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas (CO) from a motor vehicle exhaust or sulfur dioxide (SO_2) released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone — one of the many secondary pollutants that make up photochemical smog. Ozone is a product from fossil fuel combustion. When pollutants such as hydrocarbons and nitrogen oxides react with sunlight, to produce ozone following a series of free radical reactions. Photochemical smog is a complex pollutant generated when hydrocarbons and oxides of nitrogen react in strong sunlight, forming a series of secondary pollutants [1]

Some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

Transportation is the major source of air pollution in the West Bank. Three factors make traffic pollution more serious. First, most of the used vehicles are in poor conditions and of old models. Second, low quality fuels are mostly used. Third, the road networks in the West Bank are in poor conditions. This pollution is not assessed and there are no surveys about air pollutants. Air pollution is growing with the increase in population, as well as number of vehicles. In Palestine, transportation is the largest energy consumer sector reaching more than 60% of the total energy source used. Burning of fuel in internal combustion engines releases different pollutant to air such as NO_x, VOCs, CO, PM and others [2].

So, the only mode of transport in the West Bank is road transportation. Presently, the West Bank lacks any functional train, underground or air systems of transportation. The impact of road transportation on the environment depends on the total number of vehicles, type of vehicles, engine capacity, and year of production of vehicles in use, fuel quality and road conditions [2].

1.2. Project Scope.

There are pollutant gases in atmosphere, and these can produce from many sources, from industrial region, burning, and exhaust gases and other sources, and it can effect on human health and animals and plant crops.

It is needed to measure the pollutant gases (NO_x, CO, HC) and show how they can affects, the cause of choice west bank (high vehicle density), and the study vehicle movement (heavy and light or taxi diesel or gasoline…) to show how the vehicles quality can effect air pollution, according this data to find solving to reduce air pollution. There are many programs used to estimate emissions which emitted from vehicles. Mobile has been chosen, which one of the best programs to estimate emissions is.

Mobile6.2 will be used in this project which calculates the emission factor of pollutant gases (NO_x, CO, HC).the data which was important to this model is average temperature of the region, age distribution of vehicle and the average speed. This entire factor will be explained later.

1.3. Literature review.

Vehicle emissions are a major source of air pollution in urban areas. The impact on urban air quality could be reduced if the trends of vehicle emissions are well understood.

A strong correlation between breathing smoggy air and an increased incidence of respiratory and cardiopulmonary disease is emerging. In general, slower lung growth in children appears to be associated with exposure to constituents of smog. These findings continue to prompt new legislation associated with motor vehicle emission controls.

The transportation sector is a major source of CO emissions. Particularly in Canada, the transport sector accounts for 30 percent of total CO_2 emissions. In Ontario. Private automobiles account for 13% of Ontario's total CO_2 emissions and every automobile emits an average 4.7 tons of CO, every year. Automobiles emit Carbon Dioxide Report for Canada, 1991[2].

From a technical standpoint, CO, emissions from automobiles are mainly affected by fuels/vehicle type and driving mode. Since CO, is the product of combustion of fossil fuel, the mass of CO, emitted by vehicles can be assumed to be directly proportional to the fuel consumed by the vehicle. [Hassounah and Miller,1993] [3].

In order to find the cause of emissions from automobiles in a greater detail, it is essential to understand the mechanism of pollutant formation. In a car engine, hydrocarbon compounds in a fuel are burnt with air to release energy and provide the power to move vehicles. When the hydrocarbon is completely oxidized, only Co_2, and water are produced as a result of the chemical process. However, since complete oxidization rarely occurs in a spark-ignition (SI) engine, undesirable pollutants such as carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxides (NO_x) are occasionally produced. [Chowanietz, 1995] [4].

Aggressive air pollution control programs in the U.S. stimulated changes in engine design and emission control devices in the 1970s, and later use of reformulated gasoline and low-emission automobiles in some states also mitigated vehicle emissions. Since the phasing out of leaded gasoline in the 1970s, several oxygenated compounds, including ethanol and methyl butyl ether, have been used to enhance octane ratings and to reduce carbon monoxide emissions [5].

There is a study in 1999 by group research department for models for traffic emissions and air pollution; five separate models are integrated in one software suite to cover traffic demand, route choice, traffic flow, traffic-induced emissions and air quality. The traffic demand model follows a behavior-oriented, disaggregated approach. The dynamic route choice is calculated by an iterated simulation of the entire day. Each individual vehicle travels through the road network using a microscopic traffic flow model. Fuel consumption and exhaust gas emissions of all vehicles in the network are determined based on dynamic characteristics. Their research model summarized into: Demand route in the track, traffic flow, traffic-induced emissions to know air quality, the dynamic route choice is calculated by an iterated simulation of the entire day, traffic flow model can describe each individual vehicle travels through the road network, air quality to know the percentage of pollutant gases (NO_X, CO, CO_2, HC, VOC, O_3, N_2) and the noise and how can find the way to reduce the pollutants [5].

1.4. General information about WEST BANK

The road network in the West Bank is in poor conditions where it is not rehabilitated or maintained for many years. The poor conditions of the roads increase the congestion and hence emissions from the vehicles [2].

Traffic congestion, fumes, noise and parking are problems common to all West Bank urban areas. Added to this, traffic congestion is regularly created by the Israeli checkpoints which are placed at the entrances of all Palestinian cities and towns in the West Bank. These checkpoints are also a major inducer of vehicle pollution. The direction of dominant wind enhances the air pollution by bringing pollutants caused by Israeli traffic to the West Bank [2].

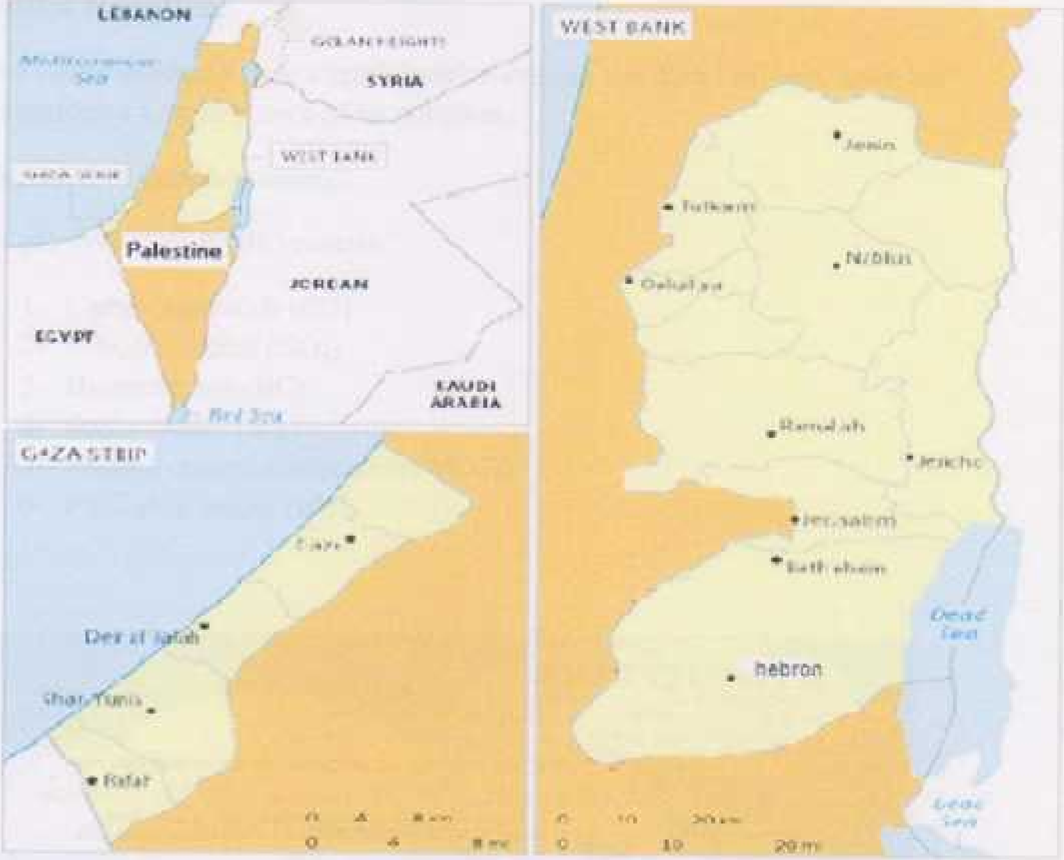

Figure2.1: map for Palestine and west bank.

Chapter Two
Automobile Emission

2.1 Emission formation

Emission can be produced from a spark ignition engines and diesel engines, emission can be considered a major source of air pollution.

2.1.1Overview of emission source:

Exhaust gas from (SIE & CIE) contain:

1- Carbon monoxide (CO)
2- Nitrogen oxides (NO_x)
3- Hydrocarbons (HC)
4- Sulfur oxides (SO_x)
5- Volatile organic compounds (VOCs)
6- Particulate matter (PM)

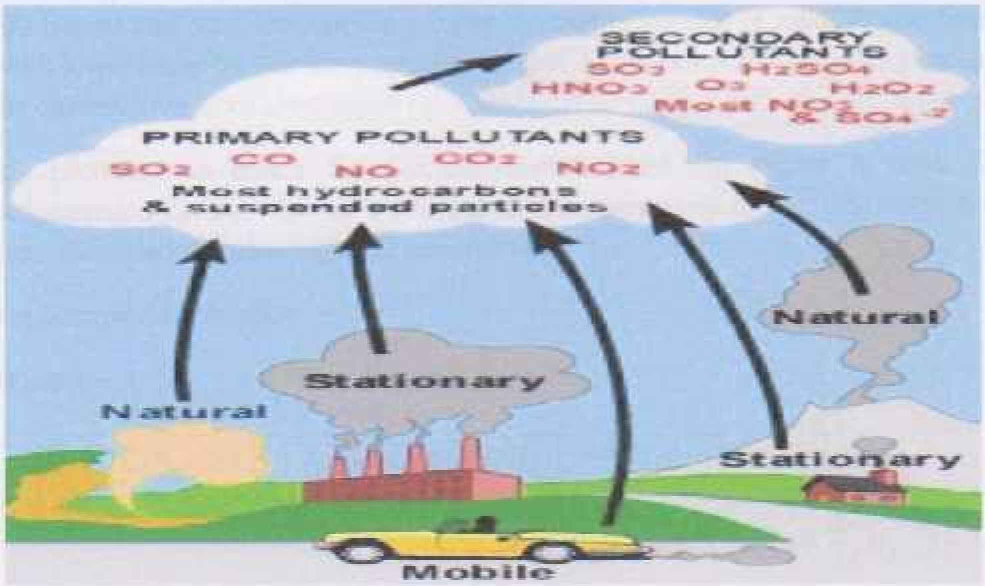

Figure2.2: Types of air pollutions

2.1.1.1 Carbon monoxide (CO)

Carbon monoxide CO is formed during combustion process, results from incomplete combustion via oxidation of molecules nitrogen and fuel.

CO in internal combustion engine (ICE) is controlled by the air –fuel excess air ratio, for air fuel ratio rich mixture, CO concentration in exhaust steadily with decreasing excess-air ratio, as equivalence ratio(ϕ)increasing ($CO = f(\lambda = \frac{1}{\phi})$ because insufficient oxygen needed ot oxidizing all carbon to CO_2 [7].

For fuel lean-mixture CO concentration in the exhaust very little with ϕ CO concentration increase rapidly in the flame zone to a maximum value (at condition close to peak temperature and pressure).

The CO formed is oxidized to CO_2:

$$CO + \mathrm{OH} \rightarrow CO_2 + 0.5H_2 \qquad 1-2$$

At condition closed to peak temperature and pressure the carbon-oxygen-hydrogen system is equilibrated, thus CO concentration in the immediate past-flame gases is closed to equilibrium [7].

During expansion stroke, the temperature decrease < 1700k the chemical reaction of CO freezes and with lean-burned mixture the higher volume of mixture also freeze (with lower flame temperature) which result in CO concentration increasing because the chemical reactions are stopped [7].

It's necessary to enrich the fuel-air mixture when the engine is cold, CO concentration during warm-up are higher than concentration in the fully warmed-up state, dissociation makes high CO concentration.

For complete combustion

When λ = 1

$$C_nH_m + \lambda\left[\left(n + \frac{m}{4}\right)(O_2 + 3.76N_2)\right] \rightarrow \left[\left(n + \frac{m}{4}\right)(1-\lambda)\right]CO_2 + \frac{m}{2}H_2O + \lambda * 3.76\left(n + \frac{m}{4}\right)N_2 \qquad 2-2$$

For this case "ideal" the pollutant gases wouldn't be found.

Where n=1,2,3,4….. and m=2n+2

For incomplete combustion

When $\lambda < 1$

$$C_nH_m + \lambda\left[\left(n+\frac{m}{4}\right)(O_2+3.76N_2)\right] \rightarrow \left[\left(n+\frac{m}{4}\right)(1-\lambda)\right]CO_2 + 2\left[\left(n+\frac{m}{4}\right)(1-\lambda)\right]CO + \frac{m}{2}H_2O + \lambda * 3.76\left(n+\frac{m}{4}\right)N_2 \qquad 3-2$$

In this case the pollutant gases will be found.

If the car in good condition it can be considered in ideal case but if it in bad condition it is considered in the second case.

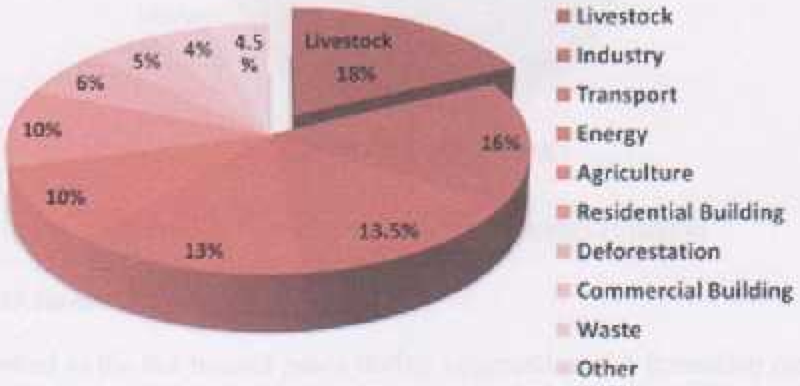

Figure 2.3: Carbon dioxide emission distribution from 2004 to 2010

In this figure it's clearly that the transportation occupied the third position in the distribution of pollutant.

Transportation sector is clearly now the major contributor of carbon dioxide emissions.

It should be noted that developing countries are rapidly increasing their transportation sector, and these countries represent a very large share of the world's population.

2.1.1.2- Nitrogen oxides (NO_x)

Nitric oxide NO, Nitrous oxide N_2O and nitrogen dioxide NO_2 are usually referred to as NO_x. NO is formed during combustion as the high flame temperature break down molecular oxygen and nitrogen from the inducted air (atmospheric air), which then recombine into NO [8].

Figure 2.5: Evolution of Nitrogen oxides emission

A- NO formation:

NO is formed in the hot burned gases during combustion, the formation rate is slow, relative to the over combustion process, and the rate increase exponentially with burned gas temperatures.

The mechanism of NO formation in a combustion system are called thermal rout of the Zeldovich-keck mechanism

$N_2+O \longrightarrow NO+N$ 4-2

$N+O_2 \longrightarrow NO+O$ 5-2

$N+OH \longrightarrow NO+H$ 6-2

Fuel is also another source of NO formation, its formed in both flame point and post flame. Combustion occurs at high pressure which rises during combustion process, so the burned gases produced early in the combustion process and compressed to a high temperature which result in NO formation [8].

The oxygen atom present behind the flame in the burned gases, this initiate the decomposition of molecular nitrogen to form NO.NO formation is a function of gas temperature and air-fuel equivalence ratio in post flame gasses. NO rises smoothly close to zero and negligible from flame [9].

B- NO2 formation:

For burned gases the NO, NO_2 is small in SIE while in CIE the NO_2 concentration can be (10-30)% of the total exhaust oxides of N emission.

Mechanism of NO_2 formation:

NO formed in the flame zone which can be rapidly converted to NO_2 as:

$NO+HO \longrightarrow NO_2 + OH^-$ 7-2

$NO_2+O \longrightarrow NO+NO_2$ 8-2

In winter the NO2 formation is quenched and converted to NO.

2.1.1.3- Hydrocarbons (HC) (unburned hydrocarbon emissions)

The Mechanism is generally produced HC are:

1. Fresh mixture is stored in combustion chamber crevices too narrow and later is released during the expansion and exhaust process.
2. Part of fuel is absorbed in oil layer during intake and compresses process and then is disrobed often normal combustion.
3. In certain condition a liquid past of fuel has no time to be evaporated and mixed with air in intake and compression stroke.
4. The flame quenches at a finite distance from cold wall surface of combustion chamber.
5. Fresh mixture escaped from combustion chamber through exhaust valve during compression and combustion process (exhaust valve leakage).
6. Incomplete combustion in a fraction of the engine operating cycle (either partial burning or complete misfire), occurring when the combustion quality is poor [9].

The physical-chemical prosperities of fuel (auto ignition temperature) thermal region of engine, combustion chamber design and engine technical state effect of HC concentration [9].

2.1.1.4 Sulfur oxides (SO_x):

Sulfur oxide SO_x is oxidized (or burned) to produced sulfur dioxide SO_2 of which fraction can be oxidizes to sulfur trioxide SO_3, which combine with water to form sulfuric acid aerosol H_2SO_4, and thus acid rain.

2.1.1.5 Volatile organic compounds (VOCs):

Volatile organic compounds are compounds that have a high vapor pressure and low water solubility. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, pharmaceuticals, and refrigerants. VOCs typically are industrial solvents, such as trichloroethylene; fuel oxygenates, such as methyl tert-butyl ether (MTBE); or by-products produced by chlorination in water treatment, such as chloroform. VOCs are often components of petroleum fuels, hydraulic fluids, paint thinners, and dry cleaning agents. VOCs are common ground-water contaminants. All the previous sources are inorganic compound [8].

The organic compound as:

1- Olefins, aromatic heterocyclic HC
2- Aldehydes C_nH_m—CHO.
3- Ketones C_nH_m—CO.
4- Phenols C_nH_m—COOH.
5- Soot and Other.

Sources of VOC

Figure 2.6: Evolution of Nitrogen oxides emission

2.1.1.6 Particular matter (PM):

The amount of PM_{10} generated from combustion engines and released via the exhaust system varies considerably. Liquid particular matter is generally categorized as white smoke and appears during a cold start, idling or low load operation and occurs when the temperature within the quench layer is not high enough to promote ignition, blue smoke is prevalent when there are oil leaks present and oil undergoes partial combustion in the cylinder. Black smoke, called soot is the most prevalent constituent of PM_{10} and is essentially carbon particles formed from oxygen deficiency in the cylinder [9].

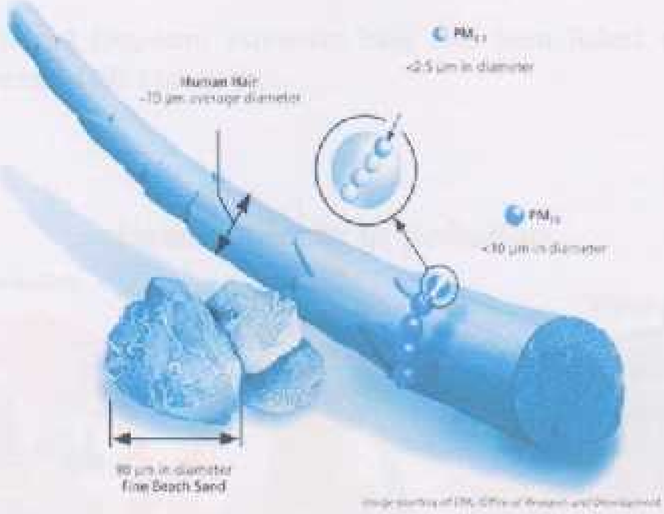

Figure 2.7: Evolution of PM emission

2.2. Emission effects on human and environment.

2.2.1 Emission effects on human.

That air pollution causes ill health and death is well recognized. Air pollution is caused by both natural and man-made sources. Major sources of ambient air pollution are the automobiles [10]

Fuel combustion is the primary source of a large number of health-damaging air pollutants, including fine and respirable particulate matter (PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NOx), and volatile organic compounds (VOCs) [10]

Air pollution has both acute and chronic effects on human health. Health effects range anywhere from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution has been shown to cause acute respiratory infections in children and chronic bronchitis in adults. It has also been shown to worsen the condition of people with preexisting heart or lung disease. Among asthmatics, air pollution has been shown to aggravate the frequency and severity of attacks [10]

Both short-term and long-term exposures have also been linked with premature mortality and reduced life expectancy.

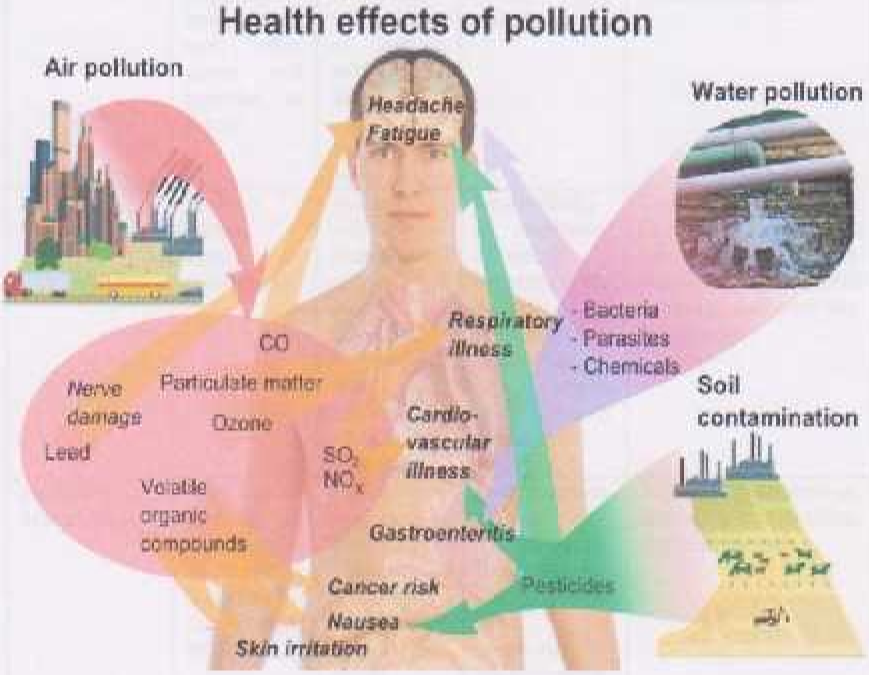

Figure 2.8: Emission effects on human and environment

(Table1) summarized the sources, health and welfare effects for the Criteria Pollutants

Table 2-1: Sources, Health and Welfare Effects for Criteria Pollutants.				
Pollutant	**Description**	**Sources**	**Health Effects**	**Welfare Effects**
Carbon Monoxide(CO)	Colorless, odorless gas	Motor vehicle exhaust, indoor sources include kerosene or wood burning stoves .	Headaches reduced mental alertness, heart attack, cardiovascular diseases, impaired fetal development, death .	Contribute to the formation of smog .
Sulfur Dioxide SO_2	Colorless gas that dissolves in water vapor to form acid, and interact with other gases and particles in the air .	Coal-fired power plants, petroleum refineries, manufacture of sulfuric acid and smelting of ores containing sulfur .	Eye irritation, wheezing, chest tightness, shortness of breath, lung damage .	Contribute to the formation of acid rain, visibility impairment, plant and water damage, aesthetic damage .
Nitrogen Dioxide (NO_2)	Reddish brown, highly reactive gas .	Motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels .	Susceptibility to respiratory infections, irritation of the lung and respiratory symptoms)e.g., cough, chest pain, difficulty breathing .(	Contribute to the formation of smog, acid rain, water quality deterioration, global warming, and visibility impairment .
Particulate Matter (PM)	Very small particles of soot, dust, or other matter, including tiny droplets of liquids .	Diesel engines, power plants, industries, windblown dust, wood stoves .	Eye irritation, asthma, bronchitis, lung damage, cancer, heavy metal poisoning, cardiovascular effects .	Visibility impairment, atmospheric deposition, aesthetic damage

Table 2-1 is to illustrate the pollutant and health effect

Hazardous air pollutants may cause other less common but potentially hazardous health effects, including cancer and damage to the immune system, and neurological, reproductive and developmental problems .Acute exposure to some hazardous air pollutants can cause immediate death.

2.2.2 Effect of air pollution on environment.

Smog hanging over cities is the most familiar and obvious form of air pollution. But there are different kinds of pollution—some visible, some invisible—that contribute to global warming. Generally any substance that people introduce into the atmosphere that has damaging effects on living things and the environment is considered air pollution [11].

Carbon dioxide, a greenhouse gas, is the main pollutant that is warming Earth. Though living things emit carbon dioxide when they breathe, carbon dioxide is widely considered to be a pollutant when associated with cars, planes, power plants, and other human activities that involve the burning of fossil fuels such as gasoline and natural gas. In the past 150 years, such activities have pumped enough carbon dioxide into the atmosphere to raise its levels higher than they have been for hundreds of thousands of years [11].

Other greenhouse gases include methane—which comes from such sources as swamps and gas emitted by livestock—and chlorofluorocarbons (CFCs), which were used in refrigerants and aerosol propellants until they were banned because of their deteriorating effect on Earth's ozone layer [12].

Another pollutant associated with climate change is sulfur dioxide, a component of smog. Sulfur dioxide and closely related chemicals are known primarily as a cause of acid rain. But they also reflect light when released in the atmosphere, which keeps sunlight out and causes Earth to cool [11].

Chapter Three

Mobile Source Emission Factor Model

3.1 General description about MOBILE6.2

3.1.1 BACKGROUND

MOBILE6 is a software application program that provides estimates of current and future emissions from highway motor vehicles. The latest in a series of MOBILE models dating back to 1978, MOBILE6 calculates average in-use fleet emission factors for:

- Three criteria pollutants: hydrocarbons (HC); carbon monoxide (CO); and oxides of nitrogen (NO_x).
- Gas, diesel, and natural-gas-fueled cars, trucks, buses, and motorcycles.
- Calendar years between 1952 and 2050.

MOBILE6 was designed by the U.S. Environmental Protection Agency (EPA) to address a wide variety of air pollution modeling needs. Written in Fortran and compiled for use in the desktop computer environment, the model calculates emission rates under various conditions affecting in-use emission levels (e.g., ambient temperatures, average traffic speeds) as specified by the modeler. MOBILE models have been used by EPA to evaluate highway mobile source control strategies; by states and local and regional planning agencies to develop emission inventories and control strategies for State Implementation Plans under the Clean Air Act; by metropolitan planning organizations and state transportation departments for transportation planning and conformity analysis; by academic and industry investigators conducting research; and in developing environmental impact statements [13].

3.1.2 MOBILE6 SCOPE

MOBILE6 includes default values for a wide range of conditions that affect emissions. These defaults are designed to represent "national average" input data values. Users who desire a more precise estimate of local emissions can substitute information that more specifically reflects local conditions. Use of local input data will be particularly common when the local emission inventory is to be constructed from separate estimates of roadways, geographic areas, or times of day, in which fleet or traffic conditions vary considerably. A list of MOBILE6 input parameters is provided below. Most of these inputs are optional because the model will supply default values unless alternate data are provided. At a minimum, users must provide input data for calendar year, minimum and maximum daily temperature, and fuel volatility.

There are three types of MOBILE6 input files: command files, batch files, and external data files. All three types must be ASCII DOS text files and may not contain "tab" characters or non-ASCII characters in any input line. Command input files are the method for users to specify what sorts of results are needed from MOBILE6. External data files are associated with some individual commands [13].

3.1.3 Data required for mobile 6.2

MOBILE6 Input Parameters

1- Calendar year
2- Month (January, July)
3- Hourly Temperature
4- Altitude (high, low)
5- Weekend/weekday
6- Fuel characteristics (Reid vapor pressure, sulfur content, oxygenate content, etc.)
7- Humidity and solar load
8- Registration (age) distribution by vehicle class
9- Annual mileage accumulation by vehicle class
10- Diesel sales fractions by vehicle class and model year
11- Average speed distribution by hour and roadway
12- Distribution of vehicle miles traveled by roadway type
13- Engine starts per day by vehicle class and distribution by hour
14- Engine start soak time distribution by hour
15- Trip end distribution by hour
16- Average trip length distribution
17- Hot soak duration
18- Distribution of vehicle miles traveled by vehicle class
19- Full, partial, and multiple diurnal distribution by hour

20- Inspection and maintenance (I/M) program description
21- Anti-tampering inspection program description
22- Stage II refueling emissions inspection program description
23- Natural gas vehicle fractions
24- HC species output
25- Particle size cutoff
26- Emission factors for PM and HAPs
27- Output format specifications and selections [13].

The data which used in this project are the average temperature of the region, fuel raid vapor pressure, registration distribution of vehicle, average speed, vehicle mile traveled fraction, and hourly vehicle mile travelled distribution input, speed distribution by time of day, Calendar year evaluation of month, absolute humidity, cloud cover and sunrise sunset [13].

The sensitivity analysis of MOBILE6, Based on the major factors in the emission rate of vehicles are temperature, age distributions (REG DIST) and average speeds. If you have reasonable values for these important parameters, you should get a good result. Having the additional information you have listed should further improve the simulation. The entire factor will be explained later [13].

3.1.4.1 MOBILE6 Vehicle Classifications

Table 3.1 show the MOBILE6 vehicle classifications, the abbreviation and the description of each type [13].

Table 3.1 **MOBILE6 Vehicle Classifications**

Number	*Abbreviation*	*Description*
1	LDGV	Light-Duty Gasoline Vehicles (Passenger Cars)
2	LDGT1	Light-Duty Gasoline Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDGT2	Light-Duty Gasoline Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDGT3	Light-Duty Gasoline Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW)
5	LDGT4	Light-Duty Gasoline Trucks 4 (6,001-8,500 lbs. GVWR, greater than 5,751 lbs. ALVW)
6	HDGV2b	Class 2b Heavy-Duty Gasoline Vehicles (8,501-10,000 lbs. GVWR)
7	HDGV3	Class 3 Heavy-Duty Gasoline Vehicles (10,001-14,000 lbs. GVWR)
8	HDGV4	Class 4 Heavy-Duty Gasoline Vehicles (14,001-16,000 lbs. GVWR)
9	HDGV5	Class 5 Heavy-Duty Gasoline Vehicles (16,001-19,500 lbs. GVWR)
10	HDGV6	Class 6 Heavy-Duty Gasoline Vehicles (19,501-26,000 lbs. GVWR)
11	HDGV7	Class 7 Heavy-Duty Gasoline Vehicles (26,001-33,000 lbs. GVWR)
12	HDGV8a	Class 8a Heavy-Duty Gasoline Vehicles (33,001-60,000 lbs. GVWR)
13	HDGV8b	Class 8b Heavy-Duty Gasoline Vehicles (>60,000 lbs. GVWR)
14	LDDV	Light-Duty Diesel Vehicles (Passenger Cars)

15	LDDT12	Light-Duty Diesel Trucks land 2 (0-6,000 lbs. GVWR)
16	HDDV2b	Class 2b Heavy-Duty Diesel Vehicles (8,501-10,000 lbs. GVWR)
17	HDDV3	Class 3 Heavy-Duty Diesel Vehicles (10,001-14,000 lbs. GVWR)
18	HDDV4	Class 4 Heavy-Duty Diesel Vehicles (14,001-16,000 lbs. GVWR)
19	HDDV5	Class 5 Heavy-Duty Diesel Vehicles (16,001-19,500 lbs. GVWR)
20	HDDV6	Class 6 Heavy-Duty Diesel Vehicles (19,501-26,000 lbs. GVWR)
21	HDDV7	Class 7 Heavy-Duty Diesel Vehicles (26,001-33,000 lbs. GVWR)
22	HDDV8a	Class 8a Heavy-Duty Diesel Vehicles (33,001-60,000 lbs. GVWR)
23	HDDV8b	Class 8b Heavy-Duty Diesel Vehicles (>60,000 lbs. GVWR)
24	MC	Motorcycles (Gasoline)
25	HDGB	Gasoline Buses (School, Transit and Urban)
26	HDDBT	Diesel Transit and Urban Buses
27	HDDBS	Diesel School Buses
28	LDDT34	Light-Duty Diesel Trucks 3 and 4 (6,001-8,500 lbs. GVWR)

Many of these individual classes are in pairs: a gasoline-fueled class, and a corresponding diesel-fueled class.

These class divisions are not likely those used in local vehicle registration systems or in reporting VMT data to the Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS), so care must be taken when relating vehicle types across these data sources [13].

MOBILE6 descriptive output can report results in terms of groups of the previous individual vehicle classes, including emission rates for "all vehicles."

3.1.4.2 MOBILE6 Roadway Classifications

Table 3.2 show the MOBILE6 roadway classifications, the abbreviation and the description of each type [13].

Table 3.2 **MOBILE6 Roadway Classification**

Number	*Abbreviation*	*Description*
1	Freeway	High-Speed, Limited-Access Roadways
2	Arterial	Arterial and Collector Roadways
3	Local	Urban Local Roadways
4	Freeway Ramp	Freeway on and off ramps

3.1.4.3 MOBILE6 Pollutant Categories

Tables 3.3 show MOBILE6 pollutant categories and the description of each type [13].

Table 3.3	MOBILE6 Pollutant Categories
Number	*Description*
1	Hydrocarbons (gaseous)
2	Carbon Monoxide (gaseous)
3	Oxides of Nitrogen (gaseous)
4	Carbon Dioxide (gaseous)

3.1.4.4 MOBILE6 Hydrocarbon Categories

Table 3.4 show the MOBILE6 hydrocarbon categories, the abbreviation and the description of each type [13].

Table 3.4		MOBILE6
Number	*Abbreviation*	*Description*
1	THC	Total Hydrocarbons
2	NMHC	Non-Methane Hydrocarbons
3	VOC	Volatile Organic Compounds
4	TOG	Total Organic Gases
5	NMOG	Non-Methane Organic Gases

3.2 Input file structure

Input files **MUST**:

- Be in DOS text (ASCII) format

- NOT have a root name longer than 8 characters

• Thus, to create input files:

- Use a text editor (e.g., Notepad); or

- Use a word processor and use the "Save As" command to save as a DOS text file (beware of auto-tabbing!).

• MOBILE6 input files are broken up into three sections:

- HEADER, RUN and SCENARIO

• Certain commands can only be placed in one of these three sections.

• An END OF RUN command appears at the end to mark the end of the run and to separate multiple runs [14].

• Our input file above becomes:

Figure (3-1) and (3-2) to show how the commands can be written in MOBILE6 [14].

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

RUN DATA            :
**********    Run Section      **********

********** Scenario Section    **********
SCENARIO RECORD     : The Title Goes Here
CALENDAR YEAR       : 2000
MIN/MAX TEMP        : 72.0  92.0
FUEL RVP            : 8.7

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

Figure (3.1) to show how to write command in MOBILE6

Command names are entered in columns 1-19, column 20 is a colon, column 21 is blank, and command data are entered in columns 22 – 150 as show in figure (3-2):

```
         1         2         3         4
1234567890123456789012345678901234567890123:

SCENARIO RECORD     : The Title Goes Here
CALENDAR YEAR       : 2000
MIN/MAX TEMP        : 72.0  92.0
FUEL RVP            : 8.7
```

Figure (3.2) to show how to write command in MOBILE6

3.3. Running MOBILE6

Example

- Enter the input file name (need to include the path if in different directory than executable); or
- Drag the file into the DOS window
- Hit return [14].

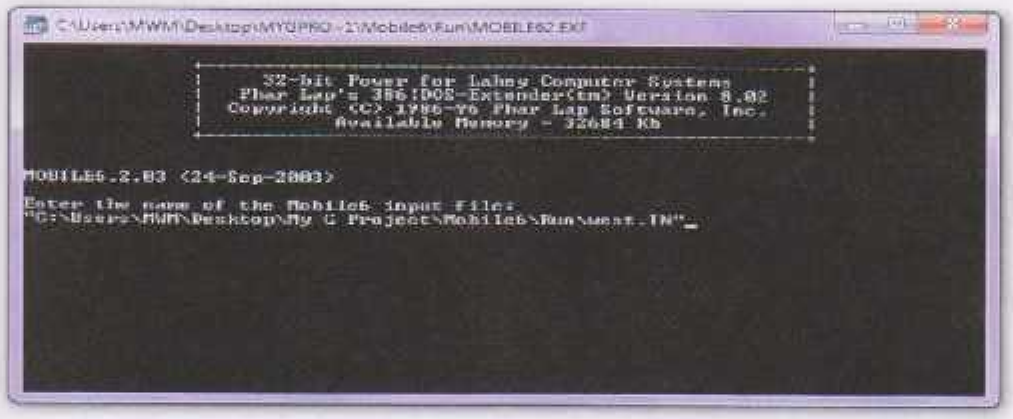

Figure (3.1) to illustrate the correct command in DOS windows

If the file name is typed incorrectly, the model will prompt the user for a different file name [14]:

Figure (3.2) to illustrate the incorrect command in DOS windows

3.4 MOBILE6 COMMANDS

3.4.1 Overview

A complete list of MOBILE6 input commands organized by function appears in this section. This section presents each MOBILE6 command in detail. The following general format is used:

Name: Full name and allowable abbreviations.

Status: required or Optional.

Section: Header, Run, or Scenario.

Description: Brief summary of what the command does.

Default: The action MOBILE6 takes, or value it applies, unless the user supplies alternative information.

Explanation: Detailed "how-to" information for users. Covers user options, model calculations, information requirements, and format specifications.

Example: Example of properly formatted input for the command [13].

3.4.2 Separator Commands

As explained in Section 3.2, a MOBILE6 command input file consists of three sections. Separator commands mark the beginning or end of a MOBILE6 command input file, as well as a Header, Run, and/or Scenario section within a MOBILE6 command input file [13].

3.4.2.1 First Record of a Regular Command Input File

Name: MOBILE6 INPUT FILE

Status: Required for all regular command input files.

Section: Header.

Description: Identifies MOBILE6 command input file as a regular file.

Default: There is no MOBILE6 default

Explanation: This command must be the first data record in a MOBILE6 input file. The data field of this record is not used and should be left blank. No additional information is required or allowed [13].

Example: MOBILE6 INPUT FILE

3.4.2.2 End of Header Section

Name: RUN DATA

Status: Required.

Section: Header.

Description: This command marks the end of the Header section and the beginning of the first Run section of a regular MOBILE6 command input file.

Default: There is no MOBILE6 default.

Explanation: This command has a purely administrative function. No information is required except for the command name [13].

Example: RUN DATA

3.4.2.3 Scenario Record

Name: SCENARIO RECORD

Status: Required.

Section: Scenario.

Description: This command serves two purposes: it marks the beginning of a new scenario, and it allows entering text to be printed at an appropriate location in the descriptive output file.

Default: There is no default. This command must be present.

Explanation: This feature permits the user to specify individual scenario calculations.

The only required information is the command name, followed by whatever scenario identifying text the user wants to appear in the descriptive output. The text must begin in column 22 of the line. At least one SCENARIO RECORD command is required in every regular MOBILE6 command input file. Additional SCENARIO

RECORD commands are necessary to generate multiple output results (e.g. multiple calendar years) [13].

Example: SCENARIO RECORD: Washington DC

3.4.2.4 End of Run

Name: END OF RUN

Status: Required.

Section: Run.

Description: This command marks the end of each Run section of a MOBILE6 command input file and is used to separate multiple MOBILE6 runs.

Default: There is no MOBILE6 default. This command must be present.

Explanation: This command must appear at the end of the last scenario of each Run section of a command input file [13].

Example: END OF RUN:

3.4.3 Commands to Specify Pollutants and Emission Rates

These commands allow the user to specify which pollutant emissions are reported and to provide alternative emission and fuel economy rates for some categories of pollutants [13].

3.4.3.1 Specifying Which Pollutants are Reported

Name: POLLUTANTS

Status: Optional.
Section: Header.

Description: Defines which of a basic set of pollutants (HC, CO, NOx, and CO_2) that MOBILE6 reports.

Default: MOBILE6 calculates HC, CO, and NO_x and writes results for these three pollutants to any output files produced.

Explanation: The pollutant types are specified by the character strings HC, CO, NOx and CO_2.The three pollutant types may appear in mixed case, but each value must be separated from the next by one or more blanks. If the users select this command but do not specify any pollutant then <u>no</u> results are produced for HC, CO, NOx [13].

Example: POLLUTANTS: NOX CO

This input specifies that NOx and CO emissions will be reported and that HC and CO_2 emissions will not be reported [13].

3.4.3.2 Hydrocarbon (HC) Emissions Speciation

NOTE: This section covers five commands with similar functions and requirements.

Name: 1- EXPRESS HC AS NMHC: 2-EXPRESS HC AS NMOG: 3-EXPRESS HC AS THC: 4-EXPRESS HC AS TOG: 5-EXPRESS HC AS VOC:

Status: Optional

Section: Run

Description: These commands allow the user to specify the particular HC species that is reported in the exhaust emission output.

Default: the HC speciation command hasn't been entered, MOBILE6 will the report the exhaust HC emissions in terms of volatile organic compounds [13].

Example: 1- EXPRESS HC AS NMHC:

3.4.3.3 No Refueling Emissions

Name: NO REFUELING

Status: Optional

Section: Run

Description: This command directs MOBILE6 not to calculate the refueling emissions from gasoline-fueled vehicles. Thus, the composite hydrocarbon emissions reported to descriptive output will not include refueling emissions

Default: MOBILE6 reports refueling emissions if this command is not specified.

Explanation: The command name is the only required information [13].

Example: NO REFUELING:

3.4.3.4 Descriptive Output

Descriptive output commands allow to specify the name and content of descriptive output files.

Name: REPORT FILE

Status: Optional.

Section: Header.

Description: This command identifies the descriptive output files. (Including the descriptive output files for HC, CO and NO_X).

Default: Any HC, CO, and NOx output will be written to a descriptive file named with the input file name root plus the extension, ".TXT". The default open action is REPLACE.

Explanation: The file name is the only required data item for this record and can be placed anywhere in the data field of the record [13].

Example: REPORT FILE: feb02.txt

3.4.4 External Condition Commands

External condition commands allow to specify the time frame, altitude, and weather conditions they wish to model [13].

3.4.4.1 Calendar Year of Evaluation

Name: CALENDAR YEAR

Status: Required.

Section: Scenario.

Description: This command identifies the calendar year for which emission factors are to be calculated, often referred to as "calendar year of evaluation."

Default: There is no MOBILE6 default. Users must supply this information.

Explanation: MOBILE6 can model emission factors for the calendar years 1952 to 2050, inclusive. A four-digit value for the calendar year of evaluation must be entered anywhere in the data portion of the record [13].

Example: CALENDAR YEAR: 2015

This input directs MOBILE6 to report emissions for the calendar year 2015.

3.4.4.2 Month of Evaluation (January or July)

Name: EVALUATION MONTH

Status: Optional.

Section: Scenario

Description: This command provides the option of calculating emission factors for January 1 or July 1 of the calendar year of evaluation.

Default: January or "1".

Explanation: MOBILE6 allows the choice of January 1 or July 1.To select July 1, enter a value of "7" anywhere in the data portion of the record [13].

Example: EVALUATION MONTH:

3.4.4.3 Daily Temperature Range

Name: MIN/MAX TEMPERATURE

Status: Required.

Section: Run or Scenario.

Description: This command sets the minimum and maximum daily temperatures to model in a given run or scenario.

Default: There is no MOBILE6 default. It must be supplied either daily minimum and maximum temperatures with this command.

Explanation: MOBILE6 uses the minimum and maximum daily temperatures to perform several calculations [13].

- The allowable minimum temperature range is 0°F to 100°F (-18°C to 38°C).
- The allowable maximum temperature range is 10°F to120°F (-12°C to 49°C)

Example: MIN/MAX TEMPERATURE: 60.84.

3.4.4.4 Absolute Humidity

Name: ABSOLUTE HUMIDITY

Status: Optional.

Section: Run or Scenario.

Description: This command is used to specify a daily average for humidity.

Default: 75 grains per pound absolute or specific humidity.

Explanation: The humidity value affects NOx emissions [13].

Example: ABSOLUTE HUMIDITY: 115.0

3.4.4.5 CLOUD COVER

Name: CLOUD COVER

Status: Optional.

Section: Run or Scenario.

Description: This command allows to specify an average percent cloud cover for a given day. This feature affects only the air conditioning correction.

Default: Zero percent.

Explanation: The CLOUD COVER command requires one value in the data portion of the record that signifies the average fraction of cloud coverage [13].

Example: CLOUD COVER: 0.90

3.4.4.6 SUNRISE/SUNSET

Name: SUNRISE/SUNSET

Status: Optional.

Section: Run or Scenario.

Description: This command allows to specify the time of sunrise and sunset.

Explanation: The SUNRISE/SUNSET command requires two integers in the data portion of the record. The first one represents the hour of sunrise, and the second represents the hour of sunset. The first value (sunrise) must be between 5 a.m. and 9 a.m. The second value (sunset) must be between 5 p.m. and 9 p.m. The integers must be separated by one or more blank spaces [13].

Example: SUNRISE/SUNSET: 6 9

3.4.5 Vehicle Fleet Characteristic Commands

Fleet characteristic commands allow to describe a given fleet by vehicle age, power source, and activity level. Several of these commands involve vehicle age. In MOBILE6, vehicle age always involves a 25-year range, with vehicles 25 years and older grouped together. The range may be expressed as 0 to 24 years (age = calendar year - model year); alternatively its values may be considered to range from 1 to 25 years (age = calendar year - model year +1). Calendar year is the year being modeled and may vary by MOBILE6 scenario [13].

3.4.5.1 Distribution of Vehicle Registrations

NAME: REG DIST

Status: Optional

Section: Run.

Description: This command allows to supply vehicle registration distributions by vehicle age for any of the 16 composite (combined gas and diesel) vehicle types.

Default: MOBILE6 applies a registration distribution for each of the 16 composite vehicle types based on U.S. vehicle fleet data.

Explanation: MOBILE6 may specify vehicle registration data for each of 25 vehicle ages for one or more of the 16 composite vehicle types listed in (Table1, Appendix B). This command <u>requires</u> an <u>external</u> data file. The command line in the command input file contains the command and external data file names. The format for the external data file is as follows:

- The first line contains the command name.
- The next line contains the composite vehicle type followed by 25 age fractions, representing the fraction of vehicles of that age in that composite vehicle class in July. MOBILE6 will use these fractions directly if a July

evaluation date is requested or will convert them to January if the user requests that evaluation date.

- This line is repeated for any vehicle categories which wish to specify.
- The vehicle type is represented by an integer from 1 to 16. See Table 1, Appendix B for the number associated with each of the 16 composite vehicle types.
- The vehicle age fractions are represented by decimals (0.000 through 1.000) for each of the 25 model years, starting with the youngest. The last fraction represents vehicles aged 25 years and older in the fleet being modeled.

The values may appear in any row with as many characters as needed, as long as 25 values follow the integer value and each value is separated by at least one blank space. all 25 values of the distribution must be entered for any vehicle class [13].

Example: REG DIST: REGDATA.D appendix D

3.4.5.2 VMT BY FACILITY

Name: VMTBY FACILITY

Status: Optional.

Section: Run or Scenario.

Description: This command allows users to allocate VMT to various roadway or facility types by vehicle class.

Default: MOBILE6 uses national estimates of the distribution of VMT by facility type.

The default values are the same for every vehicle type.

Explanation: The VMT BY FACILITY command allows users to enter VMT distributions for each of the 28 vehicle classes (table 3.1) across four roadway types for each of the 24 hours of the day. These data must be entered in an external data file, which contains the VMT BY FACILITY command name in the first column of the first row. Following the command name, the user must enter the vehicle class number (ranges from 1 to 28) and the 96 VMT fractions representing the fraction of travel on each roadway type at each hour of the day for that vehicle class. If the user is permitted to enter VMT fractions (in blocks of 96 VMT fractions) for any individual vehicle class, or for any number of vehicle classes up to 28 classes. A vehicle class number must precede the block of VMT fractions. If the user chooses to enter VMT fractions for less than all of the 28 vehicle classes, the program will use default VMT fractions for the vehicle classes unspecified by the user [13].

For a given vehicle class, the VMT fractions must be entered as 24 values for each successive hour of the day starting with 6 a.m. (see Table 3, Appendix B). There must be four sets of 24 values corresponding to the four facility types, and the four sets must be entered in the following order: freeway, arterial, local, and ramp. (Table 2, appendix B)

Within the external file, the input may appear in free column format, but at least one space must separate each numerical value. The distributions for each hour must add up to 1. If they do not, MOBILE6 will automatically normalize them [13].

Example: VMT BY FACILITY: FVMT.def   appendix F

3.4.5.3 VMT BY HOUR

Name: VMT BY HOUR

Status: Optional.

Section: Run or Scenario.

Description: This command allows to allocate the fraction of VMT that occurs at each hour of the day.

Default: MOBILE6 uses national data for the default distribution of VMT by hour

Explanation: This command permits the user to allocate total VMT among the 24 hours of each day. The values for the command are independent of facility type, that is, the VMT fraction covers all facility types.

The format for this command calls for an external file, which contains the VMT BY HOUR command name as its first entry, starting in the first column of the first row. This must be followed by the 24 VMT fractions, one value for each of the 24 hours of the day. At least one space must separate each numerical value. The 24 values must add up to 1 [13].

Example: VMT BY HOUR: HVMT.def

3.4.5.4 SPEED VMT

Name: SPEED VMT

Status: Optional

Section: Run or Scenario.

Description: This command allows to allocate VMT by average speed on freeways and arterial roads.

Default: MOBILE6 uses national fleet data for the default distribution of VMT by average speed for freeways and arterial roadways, (see Table 4, Appendix B).

Explanation: The SPEED VMT command name permits the user to enter the VMT distribution over preselected average speed ranges. MOBILE6 calculates these distributions for each of the 24 hours of the day and for freeways and arterials (producing 48 separate distributions, each containing 14 fractions).

The 14 average speed fractions (0.0000 through 1.0000) must add up to 1. The first of the 14 preset speeds is "idle," and the other 13 average speeds range from 5 mph to 65 mph in 5 mph increments. Appendix G describes in more detail the average speed ranges represented by each speed bin.

This pattern must be repeated for each combination of roadway type (arterial and freeway) and time of day to create the 48 lines. Distributions must be entered for all facility types and hours [13].

Example: SPEED VMT: SVMT.def

3.4.6 Fuel Commands

Fuel commands allow users to model the impact of various gasoline fuel parameters.

3.4.6. 1 Fuel Reid Vapor Pressure (RVP)

Name: FUEL PROGRAM

Status: Optional.

Section: Run

Description: This command allows to specify fuel RVP for the area to be modeled.

Default: There is no MOBILE6 default for fuel RVP. it must enter a value for all scenarios (in the Run section) or for each scenario (in the Scenario section) of each MOBILE6 command input file.

Explanation: RVP is one measure of the volatility of gasoline. Exhaust and especially non- exhaust emissions vary with fuel volatility. The FUEL RVP command specifies the value of RVP (in psi) representing the prevailing average fuel volatility for the geographic area of interest.

The RVP value entered must reflect the average in-use RVP of gasoline in the region of the country being modeled. The RVP value can be between 6.5 psi and 15.2 psi, inclusive [13].

Example: FUEL RVP: 9.0

Chapter Four:

Estimation of traffic induced pollution in Palestine

Over the last two decades, the number of vehicles in the West Bank has increased dramatically. The annual increasing rates of private cars and other vehicle are estimated at 12% and 6% respectively. Between 1975 and 1996, the number of vehicles increased ten times from about 12,964 in 1975 to an estimated 133,386 after the emerging of the Palestinian National Authority (PNA) in the Palestinian major cities [2].

Calculations are for private cars only based on estimates that the average production year is 1981- 1984, average engine capacity is between 1400-2000 and the total yearly distance traveled by such car is 20,000 kilometers. Thus, at least 45,385 tons of CO, 3,258 tons of SO_x, 3,723 tons of NO_x, 5,500 tons of HC, and 212 tons of lead were emitted to the West Bank's atmosphere in 1996, considering the number of registered cars only. Added to this, the 36,500 settlers' cars in the West Bank are estimated to emit around 11,483 tons of CO, 1,183 tons of SO_x, 1,299 tons of NO_x, 1,628 of HC, and 80 tons of lead to the West Bank atmosphere [2].

For all previous reasons and because there is no specific emission standards for air pollutants which are the main instrument in any air pollution control program, so this project tries to introduce *a simulation model to estimate traffic emission.*

This simulation will be done by using MOBILE6.2 since it has a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation, and in solving technical computing problems.

The MOBIL6.2 code can integrate with other program, languages and applications, such as I\M program

Unfortunately I asked the Ministry of Transport and Communications Palestinian to provide me some statistical data, and I stay about one month for their reply but they didn't, by chance I have founded data about Vigo city in north-west Spain and I use it in the model and whenever I received the data I asked to the Ministry of Transport and Communications Palestinian I can reformulated it with easy on the model.

Chapter Four:

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The geographical area of Vigo County, County high and state high shows in figure (4.1)[15].

Figure 4.1: Vigo County Area

4.1 Model Networks

Traffic modeling for air quality conformity analysis used five separate networks for 2002,2010, 2015, 2020, and 2030, each with a specific trip table and traffic assignment for the associated analysis years. The milestone years were:

- 2002 - for baseline year test
- 2010 - near-term year
- 2015 - interim year
- 2020 - interim year
- 2030 - horizon year of the transportation plan

Each model network represents transportation improvement projects that are included in the amended transportation plan to be open to traffic by January 1 of the various milestone years [15].

The estimation of emitted emission based on the Long Range Transportation Plane (LRTP) and Transportation Improvement Program (TIP) [15].

Appendix C contains a list of the specific transportation improvement projects included in each of the model networks for the milestone years.

4.2 Block diagram

In this project MOBILE6 will be used to estimate emission by enter entering local parameter such as minimum and maximum temperature, fuel RVP, age distribution, DVMT ...etc. the output appear in the form of emission factor.

On road emissions result from the multiplication of average daily VMT (DVMT) with emission factor. Figure 4.2 describe this operation.

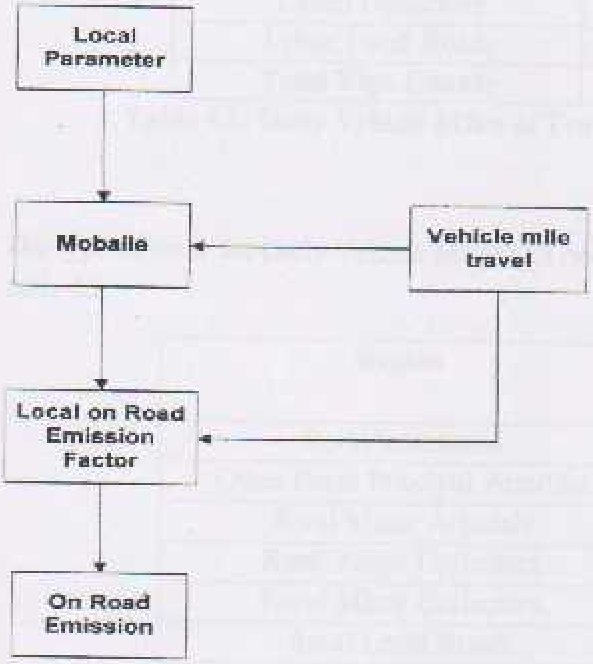

Figure 4.2: block diagram for MOBILE6

Mobile6 input and output files for each modeled year are included as Appendices D through G.

4.3 Data for vehicle mile travel

The type of road, the Daily Vehicle Miles of Travel and the total DVMT shows in table 4.1

Region	DVMT
Rural Interstates	110,137
Other Rural Principal Arterials	245,826
Rural Minor Arterials	41,818
Rural Major Collectors	240,774
Rural Minor Collectors	64,654
Rural Local Roads	92,267
Urban Interstates	336,481
Other Urban Freeways	-
Other Urban Principal Arterials	989,596
Urban Minor Arterials	624,996
Urban Collectors	226,879
Urban Local Roads	347,661
Total Vigo County	**3,321,088**

Table 4.1: Daily Vehicle Miles of Travel for 2002 Scenario [15].

The type of road, the Daily Vehicle Miles of Travel and the total DVMT shows in table 4.2

Region	DVMT
Rural Interstates	127,931
Other Rural Principal Arterials	270,341
Rural Minor Arterials	44,196
Rural Major Collectors	246,977
Rural Minor Collectors	64,260
Rural Local Roads	91,797
Urban Interstates	346,800
Other Urban Freeways	71,693
Other Urban Principal Arterials	963,151
Urban Minor Arterials	585,913
Urban Collectors	275,376

Urban Local Roads	391,480
Total Vigo County	**3,479,916**

Table 4.2: Daily Vehicle Miles of Travel for 2010 Scenario [15].

The type of road, the Daily Vehicle Miles of Travel and the total DVMT shows in table 4.3

Region	DVMT
Rural Interstates	139,073
Other Rural Principal Arterials	283,948
Rural Minor Arterials	45,664
Rural Major Collectors	255,214
Rural Minor Collectors	64,481
Rural Local Roads	93,582
Urban Interstates	357,507
Other Urban Freeways	110,839
Other Urban Principal Arterials	957,829
Urban Minor Arterials	603,735
Urban Collectors	275,584
Urban Local Roads	377,510
Total Vigo County	**3,564,966**

Table 4.3: Daily Vehicle Miles of Travel for 2015 Scenario [15].

The type of road, the Daily Vehicle Miles of Travel and the total DVMT shows in table 4.4

Region	DVMT
Rural Interstates	150,207
Other Rural Principal Arterials	293,925
Rural Minor Arterials	46,992
Rural Major Collectors	262,899
Rural Minor Collectors	66,963
Rural Local Roads	96,131
Urban Interstates	378,130
Other Urban Freeways	114,795
Other Urban Principal Arterials	980,234
Urban Minor Arterials	612,804

Urban Collectors	278,117
Urban Local Roads	401,815
Total Vigo County	**3,683,011**

Table 4.4: Daily Vehicle Miles of Travel for 2020 Scenario [15].

The type of road, the Daily Vehicle Miles of Travel and the total DVMT shows in table 4.5

Region	DVMT
Rural Interstates	172,487
Other Rural Principal Arterials	314,983
Rural Minor Arterials	49,758
Rural Major Collectors	280,081
Rural Minor Collectors	71,803
Rural Local Roads	102,299
Urban Interstates	418,832
Other Urban Freeways	119,583
Other Urban Principal Arterials	1,037,391
Urban Minor Arterials	618,169
Urban Collectors	283,538
Urban Local Roads	414,447
Total Vigo County	**3,883,373**

Table 4.5: Daily Vehicle Miles of Travel for 2030 Scenario [15].

4.4 EMISSIONS CALCULATIONS

To converting the emission factor from g/mile to emission rate tons/day, this reading had been taken form appendix D output

Year	CO *g/mile*	CO *Tons/day*
2002	19.956	27.9
2010	9.639	36.89
2015	7.568	29.68

2020	6.733	27.27
2030	6.349	27.12

Table 4.6: converting emission factor from g/mile to emission rate tons/day

Emissions estimates result from the multiplication of average daily VMT (DVMT), adjusted for seasonal variation; with the appropriate emission factors. The resulting emissions are converted from grams per day into tons per day. An example of the calculations used for developing emissions in tons per day is described below: [16]

Year	2002
Pollutant	CO
Emission Factor (gram/mile)	19.956
DVMT	3321088

Table 4.7: Sample of calculations

$CO = 19.956x\ 1.1x10^{-6}\ x\ DVMT = 19.956x\ 1.1x10^{-6}\ x3321088 = 72.9$ tons/day

Where: the Conversion Factor (grams to tons) = 1ton/2000 lbs. X 2.2 lbs./1 kg X 1 kg/1000 grams $=1.1X10^{-6}$ tons/gram

Table 4.8 shows the total daily vehicle mile traveled in each year, the amount of violate organic compounds, nitrogen oxides and carbon monoxide in tons per day.

The 2002 year is the base line and the other year is expected depending on long range transportation plane (LRTP) and transportation improvement program (TIP) [15].

		VOC	NOX	CO
Year	**Daily VMT**	**Mobile6 Tons/day**	**Mobile6 Tons/day**	**Mobile6 Tons/day**
2002	3,321,088	5.72	10.27	27.9
2010	3,479,916	2.98	5.40	36.89
2015	3,564,966	2.04	3.15	29.68
2020	3,683,011	1.63	2.12	27.27
2030	3,883,373	1.48	1.51	27.12

Table 4.8: Results of Emissions Rate Summary

Analysis of result:

These figures summarize the amount of emitted emission tons per day according to each year.

Figure 4.3: shows amount of daily emission (tons/year) for NOx per year.

The previous diagram shows that the amount of emission in 2002 is 10.27 tons per day and it's reduced dramatically in 2010 to 5.4 tons per day. In 2030 if the (LRTP) and (TIP) is applied correctly the amount of emission will reduced to 1.51 tons per day and its good result.

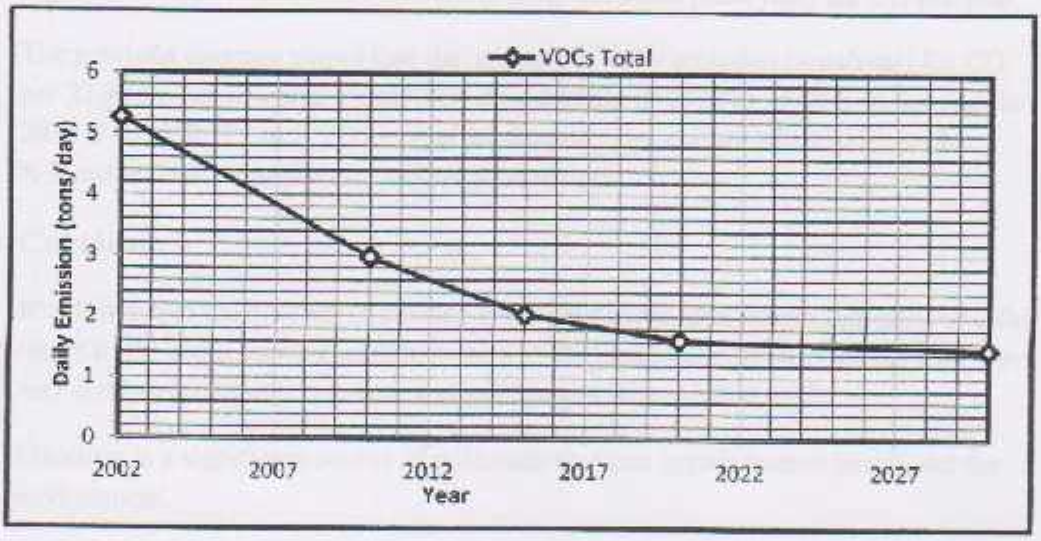

Figure 4.4: shows amount of daily emission (tons/year) for VOCs per year

The previous diagram shows that the amount of emission in 2002 is 5.72 tons per day and it's reduced dramatically in 2010 to 2.98 tons per day. In 2030 if the (LRTP) and (TIP) is applied correctly the amount of emission will reduced to 1.48 tons per day and its good result.

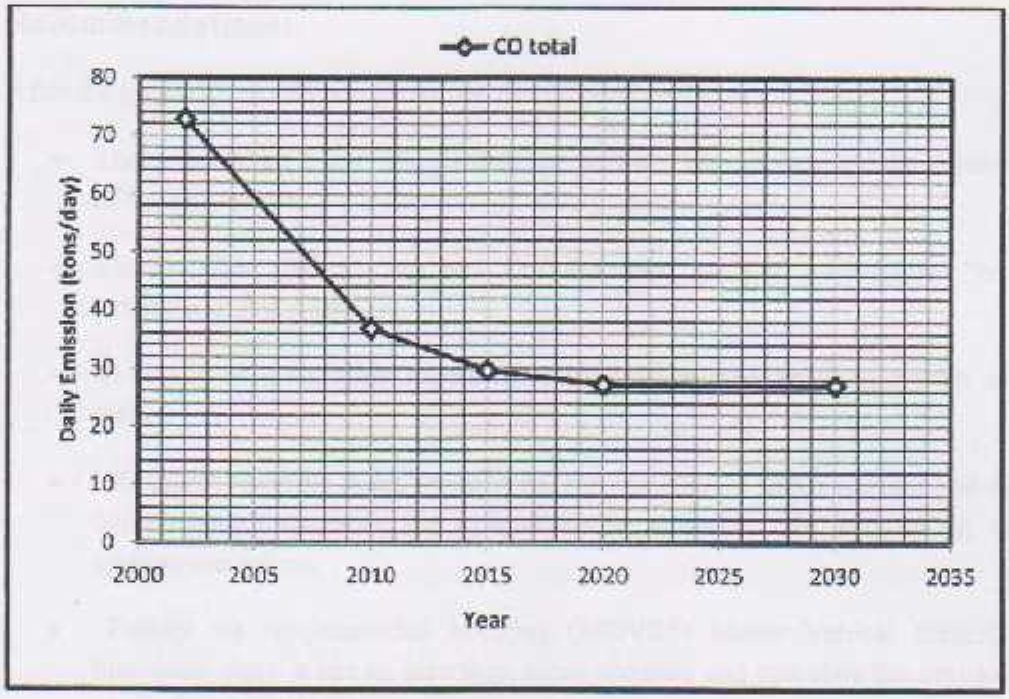

Figure 4.5: Figure 4.4: shows amount of daily emission (tons/year) for CO per year.

The previous diagram shows that the amount of daily emission (tons/year) for CO per 27.9 tons per day and it's reduced dramatically in 2010 to 36.89 tons per day. In 2030 if the (LRTP) and (TIP) is applied correctly the amount of emission will reduced to 27.12 tons per day and its good result.

Conclusion:

It's clearly that the amount of emitted emission can be reduced dramatically, and this return to the improvement vehicle system as the design of combustion chamber, three way catalytic convertor, canister and exhaust gas recirculation EGR.

Emission is a significant source of pollutants that can impair human health and the environment.

The estimation of emitted emission on future based on the Long Range Transportation Plane (LRTP) and Transportation Improvement Program (TIP).

The assumption select gases CO, VOCs and NOx Because these gases have a direct impact on the ozone layer so that these gases are unstable and interact with ozone to reach a state of stability and this leads to expansion of the ozone hole and therefore has been to focus on these gases.

Recommendations:

After the project has been completed we recommend as follow:

- There should be a level of coordination between universities and the ministry of transportation.
- Electric Cars (hybrid car) and Vehicles must be used as possible "zero emission at low speed".
- It should be used other means of transportation such as electric train and metro.
- MOBILE6 must be recommended for the ministry of transportation and the complement authorities for estimations at emission rate and taking the appropriate action.
- Finally we recommended bringing (MOVES) Motor Vehicle Emission Simulator since it has an interface, more accurate and calculate the emission easier than MOBILE6.

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12- Greenhouse gas From Wikipedia, the free encyclopedia
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15- FY 2005-2007 TIP AND 2028 LRP CONFORMITY ANALYSIS
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Appendixes

Appendix A

Alphabetical List of MOBILE6 Commands

	Command Name	Command Input File Section	Command Parameter Type	Required command	Command Function
1	MOBILE6 INPUT FILE	Header		Yes	Identifies M6 input file as regular command input file rather than a batch file.
2	RUN DATA	End of Header		Yes	Marks end of Header section and beginning of Run section of a regular M6 command input file.
3	SCENARIO RECORD	Start of Scenario		Yes	Allows user to label individual scenario results. Marks start of new scenario.
4	END OF RUN	End of Run			Required to separate multiple runs in command input files.
5	POLLUTANTS	Header	Pollutant Choice		Controls which pollutants (HC, CO, NOx,CO_2)will be calculated and output to the database report and descriptive output.
6	EXPRESS HC AS VOC	Run	On/Off		Directs M6 to output exhaust HC as volatile organic compounds.
7	NO REFUELING	Run	On/Off		Allows user to exclude refueling emissions from all output values.
8	REPORT FILE	Header	Filename		Specifies name for descriptive output files.
9	CALENDAR YEAR	Scenario	Value	Yes	Calendar year of scenario evaluated.
10	MIN/MAX TEMP	Run or Scenario	Values	Yes	Specifies minimum and maximum daily temperatures. * This command is required unless HOURLY TEMPERATURES is used.
11	ABSOLUTE	Run or	Value		Absolute humidity in grains per pound.

	HUMIDITY	Scenario			
13	CLOUD COVER	Run or Scenario	Value		Allows user to input fraction of cloud cover for a given day
14	SUNRISE/SUNSET	Run or Scenario	Value		Specifies times for sunrise and sunset for A/C calculations.
15	REG DIST	Run	External file		Allows user to supply vehicle registration distributions by age for all 16 composite vehicles types.
16	VMT BY HOUR	Run or Scenario	External file		Allows user to supply alternate hourly distributions of VMT.
17	VMT BY FACILITY	Run or Scenario	External file		Allows user to supply alternate VMT distributions by facility type.
18	SPEED VMT	Run or Scenario	External file		Allows user to enter VMT distribution across 14 preselected average speed ranges for each of the 24 hours of the day for each scenario.
19	FUEL RVP	Run or Scenario	Values	Yes	Required input of average gasoline Reid vapor pressure.

Appendix B

MOBILE6 Input Data Format Reference Tables

Table 1: Composite Vehicle Classes for Vehicle Registration Data and Vehicle Miles Traveled Fractions (REG DIST and VMT FRACTIONS Commands)

Number	Abbreviation	Description
1	LDV	Light-Duty Vehicles (Passenger Cars)
2	LDT1	Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3,750 lbs. LVW)
3	LDT2	Light-Duty Trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)
4	LDT3	Light-Duty Trucks 3 (6,001-8,500 lbs. GVWR, 0-5,750 lbs. ALVW*)
5	LDT4	Light-Duty Trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)
6	HDV2B	Class 2b Heavy-Duty Vehicles (8,501-10,000 lbs. GVWR)
7	HDV3	Class 3 Heavy-Duty Vehicles (10,001-14,000 lbs. GVWR)
8	HDV4	Class 4 Heavy-Duty Vehicles (14,001-16,000 lbs. GVWR)
9	HDV5	Class 5 Heavy-Duty Vehicles (16,001-19,500 lbs. GVWR)
10	HDV6	Class 6 Heavy-Duty Vehicles (19,501-26,000 lbs. GVWR)
11	HDV7	Class 7 Heavy-Duty Vehicles (26,001-33,000 lbs. GVWR)
12	HDV8A	Class 8a Heavy-Duty Vehicles (33,001-60,000 lbs. GVWR)
13	HDV8B	Class 8b Heavy-Duty Vehicles (>60,000 lbs. GVWR)
14	HDBS	School Buses
15	HDBT	Transit and Urban Buses
16	MC	Motorcycles (All)

* ALVW = Alternative Loaded Vehicle Weight: The adjusted loaded vehicle weight is the numerical average of the vehicle curb weight and the gross vehicle weight rating (GVWR)

Appendix B

Table 2: MOBILE6 Input Data Format Reference Tables

VMT By facility

Speed Low		High	Type1	Type2	Type3	Type4	Total
0	-	2.5	-	-	-	-	
2.5	-	7.5	-	-	-	-	
7.5	-	12.5	-	-	-	-	
12.5	-	17.5	-	-	-	-	
17.5	-	22.5	-	-	-	-	
22.5	-	27.5	-	-	-	-	
27.5	-	32.5	6,777	18,759	8,157	1,223	
32.5	-	37.5	-	-	-	-	
37.5	-	42.5	32,523	104,430	20,552	1,500	
42.5	-	47.5	52,922	381,922	4,467	400	
47.5	-	52.5	27,248	58,392	8,432	1,001	
52.5	-	57.5	-	-	-	-	
57.5	-	62.5	-	-	-	-	1
62.5	-	67.5	1,298	1,122	176	101	
67.5	-	72.5	-	-	-	-	
Total			120,768	556,477	36,784	4,225	728,400
VMT BY FACILITY			0.1658	0.7777	0.0505	0.0058	1.0000

Appendix B

MOBILE6 Input Data Format Reference Tables

Table 3: Daily Hour Mapping for Distribution of Vehicle Starts During the Day (START DIST, HOURLY TEMPERATURE, and RELATIVE HUMIDITY Commands)

Number	Abbreviation	Description
1	6 a.m.	6 a.m. through 6:59 a.m.
2	7a.m.	7 a.m. through 7:59 a.m.
3	8 a.m	8 a.m. through 8:59 a.m.
4	9 a.m.	9 a.m. through 9:59 a.m.
5	10 a.m	10 a.m. through 10:59 a.m.
6	11 a.m.	11 a.m. through 11:59 a.m.
7	12 Noon	12 Noon through 12:59 p.m.
8	1 p.m.	1 p.m. through 1:59 p.m.
9	2 p.m.	2 p.m. through 2:59 p.m.
10	3 p.m.	3 p.m. through 3:59 p.m.
11	4 p.m.	4 p.m. through 4:59 p.m.
12	5 p.m.	5 p.m. through 5:59 p.m.
13	6 p.m.	6 p.m. through 6:59 p.m.
14	7 p.m.	7 p.m. through 7:59 p.m.
15	8 p.m.	8 p.m. through 8.59 p.m.
16	9 p.m.	9 p.m. through 9:59 p.m.
17	10 p.m	10 p.m. through 10:59 p.m.
18	11 p.m.	11 p.m. through 11:59 p.m.
19	12 Midnight	12 Midnight through 12:59 a.m.
20	1 a.m.	1 a.m. through 1:59 a.m.
21	2 a.m.	2 a.m. through 2:59 a.m.
22	3 a.m.	3 a.m. through 3:59 a.m.
23	4 a.m.	4 a.m. through 4:59 a.m.
24	5 a.m.	5 a.m. through 5:59 a.m.

Appendix B

MOBILE6 Input Data Format Reference Tables

Table 4: Average Speed Ranges for Speed Bins (SPEED VMT command)

Number	Abbreviation	Description
1	2.5 mph	Miles with average speed 0-2.5 mph
2	5 mph	Miles with average speed 2.5-7.5 mph
3	10 mph	Miles with average speed 7.5-12.5 mph
4	15 mph	Miles with average speed 12.5-17.5 mph
5	20 mph	Miles with average speed 17.5-22.5 mph
6	25 mph	Miles with average speed 22.5-27.5 mph
7	30 mph	Miles with average speed 27.5-32.5 mph
8	35 mph	Miles with average speed 32.5-37.5 mph
9	40 mph	Miles with average speed 37.5-42.5 mph
10	45 mph	Miles with average speed 42.5-47.5 mph
11	50 mph	Miles with average speed 47.5-52.5 mph
12	55 mph	Miles with average speed 52.5-57.5 mph
13	60 mph	Miles with average speed 57.5-62.5 mph
14	65 mph	Miles with average speed >62.5 mph

Appendix C: Improvement Projects Modeled

Year 2003-2010

- T-1b: 13th Street Extension – widening to four lanes from Hulman St. to I-70
- T-2: Margaret Avenue at 19th Street – new traffic signal (September 2005)
- T-4: Locust Street at 25th Street – new traffic signal (December 2004)
- T-5: 1st Street Extension – two-lane extension and reconstruction from SR 63 to Locust Street (left-turn lanes at major intersections) (to be open August 2005)
- T-6: Lafayette Avenue – add continuous center left-turn lane from Ft. Harrison Road to Haythorne Road
- T-10: Fruitridge Avenue – two-lane reconstruction with partial access control from Ft. Harrison Road to Haythorne Avenue with new traffic signal at Haythorne Avenue
- T-11: Lafayette Avenue – add continuous center left-turn lane from Lost Creek Bridge to Ft. Harrison Road
- TF-8: SR 63 at Margaret Avenue – new traffic signal (2003)
- V-2: Fruitridge Avenue at Park Avenue – intersection improvements and new traffic signal
- V-3: Canal Road/McDaniel Road – reconstruction and widening to four lanes from I-70 to SR 641
- V-4: Lafayette Avenue at Park Avenue – intersection improvements and new traffic signal
- S-2a: SR 63 at Johnson Drive – new traffic signal (part of Project SF-9a)
- S-2b: SR 63 at Springhill Drive – new traffic signal (November 2005)
- S-3: SR 641 – new four-lane freeway from US 41 to Canal Road
- S-5a: SR 641 – new four-lane freeway from Canal Road to Riley Road
- TF-3: Margaret Avenue – widening to five lanes from 13th Street to 25th Street
- TF-7a: Margaret Avenue – CSX RR underpass near 19th St (related to TF-3)
- TF-13a: Brown Avenue Extension – new two-lane (16' lanes with median) from Locust Street to Maple Avenue with new traffic signal at Locust Street and 2-lane reconstruction from Ohio Street to Locust Street
- TF-14a: Margaret Avenue – two-lane reconstruction (12-foot lanes) and realignment (west of SR 46) from 25th Street to SR 46
- TF-15 (new): Locust Street – new two-lane roadway from 25th Street to Brown Avenue (December 2004)
- VF-2a: Harlan Road – widening to five lanes from US 41 to Industrial Park Access Road
- SF-9a: SR 63 – add continuous center left-turn lane from Honey Creek Drive to US 41

Year 2011-2015

- S-5b/5c: SR 641 – new four-lane freeway from Riley Road to I-70
- TF-10: Margaret Avenue – add continuous center left-turn lane from SR 63 to 13th Street (four lanes from US 41 to 13th Street)
- TF-18 (new): 8th Avenue Extension – new two-lane roadway from Kester Avenue to Fruitridge Avenue (may be moved to Year 2003-2010 phase)
- VF-3a Lafayette Avenue – add continuous center left-turn lane from Haythorne Ave. to Hasselburger Ave.

Year 2021-2030

- TF-20 (new): 19th Street – two-lane reconstruction and realignment from Wabash Avenue to Locust Street (possibly moved up to before 2010)
- VF-9: Third Place Extension – new two-lane roadway from Johnson Road to Springhill Drive
- SF-10 (new): US 41 – widening to six lanes from Margaret Avenue to Hulman Street (SR 63) (INDOT Moved from Year 2011-2015 Timeframe)

Appendix D: Vigo County Vehicle Registration – Input File

```
REG DIST
*
* This file contains the default MOBILE6 values for the distribution of
* vehicles by age for July of any calendar year.  There are sixteen (16)
* sets of values representing 16 combined gasoline/diesel vehicle class
* distributions.  These distributions are split for gasoline and diesel
* using the separate input (or default) values for diesel sales fractions.
* Each distribution contains 25 values which represent the fraction of
* all vehicles in that class (gasoline and diesel) of that age in July.
* The first number is for age 1 (calendar year minus model year plus one)
* and the last number is for age 25.  The last age includes all vehicles
* of age 25 or older.  The first number in each distribution is an integer
* which indicates which of the 16 vehicle classes are represented by the
* distribution.  The sixteen vehicle classes are:
*
*  1  LDV     Light-Duty Vehicles (Passenger Cars)
*  2  LDT1    Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3  LDT2    Light Duty Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
*  4  LDT3    Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5  LDT4    Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
*  6  HDV2B   Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7  HDV3    Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8  HDV4    Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9  HDV5    Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10  HDV6    Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11  HDV7    Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
* 12  HDV8A   Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B   Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS    School Busses
* 15  HDBT    Transit and Urban Busses
* 16  MC      Motorcycles (All)
*
* The 25 age values are arranged in two rows of 10 values followed by a row
* with the last 5 values.  Comments (such as this one) are indicated by
* an asterisk in the first column. Empty rows are ignored.  Values are
* read "free format," meaning any number may appear in any row with as
* many characters as needed (including a decimal) as long as 25 values
* follow the initial integer value separated by a space.
*
* If all 28 vehicle classes do not need to be altered from the default
* values, then only the vehicle classes that need to be changed need to
* be included in this file.  The order in which the vehicle classes are
* read does not matter, however each vehicle class set must contain 25
* values and be in the proper age order.
*
* COUNTY 84, VIGO
* LDV
 1 0.0384 0.0513 0.0511 0.0588 0.0691 0.0702 0.0587 0.0640 0.0553 0.0677
   0.0547 0.0551 0.0488 0.0481 0.0419 0.0375 0.0276 0.0235 0.0204 0.0140
   0.0107 0.0057 0.0038 0.0034 0.0232
* LDT1
 2 0.0277 0.0369 0.0368 0.0274 0.0247 0.0264 0.0381 0.0296 0.0479 0.0513
   0.0674 0.0517 0.0427 0.0614 0.0497 0.0616 0.0509 0.0599 0.0529 0.0443
```

```
  0.0276 0.0182 0.0169 0.0141 0.0338
* LDT2
 3 0.0550 0.0733 0.0730 0.0715 0.0849 0.0841 0.0885 0.0872 0.0525 0.0538
   0.0470 0.0445 0.0339 0.0270 0.0242 0.0198 0.0253 0.0106 0.0085 0.0067
   0.0080 0.0043 0.0031 0.0024 0.0111
* LDT3
 4 0.0450 0.0600 0.0598 0.0657 0.0629 0.0799 0.0584 0.0593 0.0649 0.0666
   0.0585 0.0396 0.0352 0.0246 0.0229 0.0289 0.0199 0.0172 0.0191 0.0168
   0.0125 0.0099 0.0049 0.0037 0.0657
* LDT4
 5 0.0658 0.0877 0.0877 0.0905 0.0801 0.0946 0.0739 0.0525 0.0421 0.0580
   0.0615 0.0207 0.0110 0.0097 0.0145 0.0048 0.0076 0.0062 0.0124 0.0138
   0.55  0.0055 0.0021 0.0007 0.0911
```

*** This appendix is valid for 2010,2015,2020 and 2030**

Appendix E: Hourly VMT Distribution Input File

```
VMT BY HOUR
*
*  Fraction of all vehicle miles traveled by hour of the day.
*  Data is from a 1995 household survey.
*  First hour is 6 a.m.
*
     0.0655  0.0801  0.0624  0.0461  0.0441  0.0461
     0.0461  0.0477  0.0513  0.0862  0.0960  0.0922
     0.0513  0.0399  0.0290  0.0295  0.0306  0.0171
     0.0083  0.0047  0.0036  0.0026  0.0036  0.0161
```

*** This appendix is valid for 2010,2015,2020 and 2030**

Appendix F: Mobile6 2002 Files

2002 Scenario File: FVMT (VMT BY FACILITY BY VEHICLE CLASS BY HOUR - 2002FVMT.DEF)

```
VMT BY FACILITY
  1 0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
  2 0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
    0.1658 0.7777 0.0505 0.0058
  3 0.1658 0.7777 0.0505 0.0058
```

	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
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	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058

	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
20	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
21	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
22	0.1658	0.7777	0.0505	0.0058

	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
23	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
24	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058

	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
25	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
26	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058

	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
27	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
28	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058
	0.1658	0.7777	0.0505	0.0058

This appendix is valid for 2010,2015,2020 and 2030.

Appendix G: 2002 Scenario File: SVMT (SPEED DISTRIBTUION BY TIME OF DAY BY FACILITY – 2002SVMT.DEF)

```
SPEED VMT
1 1  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 2  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 3  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 4  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 5  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 6  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 7  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 8  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 9  0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 10 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 11 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 12 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 13 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 14 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 15 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 16 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 17 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 18 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 19 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 20 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 21 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 22 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 23 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
1 24 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.0000
2 1  0.0016 0.0004 0.0314 0.0025 0.0103 0.0243 0.1137 0.0971 0.2162 0.1799 0.1495 0.0547 0.1371 0.0004
2 2  0.0035 0.0124 0.0312 0.0383 0.0342 0.0336 0.1289 0.1270 0.1635 0.1220 0.1153 0.0525 0.1371 0.0005
2 3  0.0016 0.0000 0.0012 0.0007 0.0045 0.0228 0.1177 0.0909 0.1939 0.2139 0.1419 0.0624 0.1371 0.0005
2 4  0.0000 0.0000 0.0000 0.0035 0.0023 0.0056 0.0984 0.1004 0.1866 0.2387 0.1476 0.0823 0.1371 0.0006
2 5  0.0000 0.0000 0.0000 0.0000 0.0025 0.0058 0.0984 0.0963 0.1508 0.2357 0.1506 0.0823 0.1371 0.0005
2 6  0.0000 0.0000 0.0000 0.0005 0.0020 0.0056 0.0984 0.1004 0.1866 0.2287 0.1476 0.0823 0.1371 0.0006
2 7  0.0000 0.0000 0.0000 0.0005 0.0020 0.0056 0.0984 0.1004 0.1866 0.2387 0.1476 0.0823 0.1371 0.0006
2 8  0.0000 0.0000 0.0000 0.0016 0.0009 0.0066 0.0977 0.1004 0.1866 0.2387 0.1476 0.0823 0.1371 0.0005
2 9  0.0000 0.0000 0.0016 0.0004 0.0004 0.0066 0.0984 0.1043 0.1970 0.2238 0.1516 0.0782 0.1371 0.0005
2 10 0.0125 0.0346 0.0386 0.0330 0.0399 0.0641 0.1145 0.1252 0.1209 0.1187 0.1064 0.0620 0.1268 0.0005
2 11 0.0394 0.0752 0.0384 0.0608 0.0463 0.0334 0.1023 0.0912 0.1092 0.1050 0.0972 0.0886 0.0917 0.0006
2 12 0.0297 0.0553 0.0338 0.0487 0.0599 0.0879 0.1038 0.0956 0.1224 0.1051 0.0985 0.0680 0.1207 0.0006
2 13 0.0006 0.0000 0.0016 0.0004 0.0004 0.0046 0.0984 0.1043 0.1970 0.2238 0.1516 0.0783 0.1371 0.0005
2 14 0.0000 0.0000 0.0000 0.0000 0.0009 0.0075 0.0984 0.0771 0.2100 0.2248 0.1372 0.1066 0.1371 0.0004
2 15 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 16 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 17 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 18 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 19 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 20 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 21 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 22 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 23 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
2 24 0.0000 0.0000 0.0000 0.0000 0.0009 0.0058 0.1000 0.0695 0.2175 0.1810 0.1810 0.1066 0.1371 0.0006
```

This appendix is valid for 2010,2015,2020 and 2030.

2002 Scenario File: Mobile6 Input File (VIGO2002.IN)

```
MOBILE6 INPUT FILE : VIGO2002.IN

POLLUTANTS          : HC CO NOx
REPORT FILE         : VIGO2002.txt

RUN DATA

MIN/MAX TEMP        : 65. 87.3
FUEL RVP            : 7.0
EXPRESS HC AS VOC   :
NO REFUELING        :
REG DIST            : C:\Mobile6\Vigo\Regdata.d
VMT BY FACILITY     : C:\Mobile6\Vigo\2002FVMT.def
VMT BY HOUR         : C:\Mobile6\Vigo\HVMT.def
SPEED VMT           : C:\Mobile6\Vigo\2002SVMT.def

SCENARIO RECORD     : Scenario Title : Vigo County 2002

CALENDAR YEAR       : 2002
EVALUATION MONTH    : 7

ABSOLUTE HUMIDITY   : 93.7
CLOUD COVER         : 0.34

SUNRISE/SUNSET      : 6 8

END OF RUN
```

2002 Scenario File: Mobile6 Output File (VIGO2002.TXT)

```
****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                               *
* Input file: C:\WEST\WEST.IN (file 1, run 1).                             *
****************************************************************************
M603 Comment:
        User has disabled the calculation of REFUELING emissions.

* Reading Registration Distributions from the following external
* data file: C:\WEST\REGDATA.D
 M 49 Warning:
      1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
      1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
      1.00    MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: C:\WEST\2011FVMT.DEF

 Reading User Supplied ROADWAY VMT Factors

* Reading Hourly VMT distribution from the following external
* data file: C:\WEST\HVMT.DEF

* Reading Hourly, Roadway, and Speed VMT dist. from the following external
* data file: C:\WEST\2011SVMT.DEF

* #########################
* Scenario Title : west County 2002
* File 1, Run 1, Scenario 1.
* #########################
 M617 Comment:
        User supplied alternate AC input: Cloud Cover Fraction set to 0.34.
 M618 Comment:
        User supplied alternate AC input: Sunrise at  6 AM, Sunset at  8 PM.
 M 48 Warning:
        there are no sales for vehicle class HDGV8b

           Calendar Year:  2002
                  Month:  July
               Altitude:  Low
   Minimum Temperature:  65.0 (F)
   Maximum Temperature:  87.3 (F)
     Absolute Humidity:  94. grains/lb
      Nominal Fuel RVP:   7.0 psi
        Weathered RVP:   6.9 psi
   Fuel Sulfur Content:  279. ppm

     Exhaust I/M Program:  No
        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:	0.4453	0.3065	0.1159		0.0372	0.0009	0.0019	0.0861	0.0062	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.653	1.568	1.910	1.662	1.575	0.769	0.825	0.610	2.08	1.564
Composite CO :	19.57	22.07	27.61	23.59	23.98	1.455	1.474	3.273	16.13	19.956
Composite NOX :	1.283	1.393	1.628	1.458	5.336	1.903	1.768	16.354	1.21	2.806

2010 Scenario File: Mobile6 Input File (VIGO2010.IN)

```
MOBILE6 INPUT FILE :

POLLUTANTS           : HC CO NOx
REPORT FILE          : VIGO2010.txt

RUN DATA

MIN/MAX TEMP         : 65. 87.3
FUEL RVP             : 7.0
EXPRESS HC AS VOC    :
NO REFUELING         :
REG DIST             : C:\Mobile6\Vigo\Regdata.d
VMT BY FACILITY      : C:\Mobile6\Vigo\2010FVMT.def
VMT BY HOUR          : C:\Mobile6\Vigo\HVMT.def
SPEED VMT            : C:\Mobile6\Vigo\2010SVMT.def

SCENARIO RECORD      : Scenario Title : Vigo County 2010

CALENDAR YEAR        : 2010
EVALUATION MONTH     : 7

ABSOLUTE HUMIDITY    : 93.7
CLOUD COVER          : 0.34

SUNRISE/SUNSET       : 6 8

END OF RUN
```

2010 Scenario File: Mobile6 Output File (VIGO2010.TXT)

```
*****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                                *
* Input file: C:\WEST\WEST.IN (file 1, run 1).                              *
*****************************************************************************
 M603 Comment:
      User has disabled the calculation of REFUELING emissions.


* Reading Registration Distributions from the following external
* data file: C:\WEST\REGDATA.D
 M 49 Warning:
        1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
        1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
        1.00    MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: C:\WEST\2011FVMT.DEF

 Reading User Supplied ROADWAY VMT Factors

* Reading Hourly VMT distribution from the following external
* data file: C:\WEST\HVMT.DEF

* Reading Hourly, Roadway, and Speed VMT dist. from the following external
* data file: C:\WEST\2011SVMT.DEF

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Scenario Title : west County 2002
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
 M617 Comment:
      User supplied alternate AC input: Cloud Cover Fraction set to 0.34.
 M618 Comment:
      User supplied alternate AC input: Sunrise at 6 AM, Sunset at 8 PM.
 M 48 Warning:
      there are no sales for vehicle class HDGV8b

             Calendar Year:  2010
                     Month:  July
                  Altitude:  Low
       Minimum Temperature:  65.0 (F)
       Maximum Temperature:  87.3 (F)
         Absolute Humidity:  94. grains/lb
        Nominal Fuel RVP:  7.0 psi
           Weathered RVP:  6.9 psi
      Fuel Sulfur Content:  30. 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:	0.3376	0.3840	0.1449		0.0370	0.0003	0.0021	0.0884	0.0056	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.865	0.786	0.930	0.826	0.700	0.214	0.369	0.346	2.05	0.797
Composite CO :	9.95	10.42	12.06	10.87	8.54	0.958	0.654	1.602	16.13	9.651
Composite NOX :	0.649	0.751	0.980	0.814	2.410	0.578	0.758	7.408	1.21	1.402

2015 Scenario File: Mobile6 Input File (VIGO2015.IN)

```
MOBILE6 INPUT FILE :

POLLUTANTS          : HC CO NOx
REPORT FILE         : VIGO2015.txt

RUN DATA

MIN/MAX TEMP        : 65. 87.3
FUEL RVP            : 7.0
EXPRESS HC AS VOC   :
NO REFUELING        :
REG DIST            : C:\Mobile6\Vigo\Regdata.d
VMT BY FACILITY     : C:\Mobile6\Vigo\2015FVMT.def
VMT BY HOUR         : C:\Mobile6\Vigo\HVMT.def
SPEED VMT           : C:\Mobile6\Vigo\2015SVMT.def

SCENARIO RECORD     : Scenario Title : Vigo County 2015

CALENDAR YEAR       : 2015
EVALUATION MONTH    : 7

ABSOLUTE HUMIDITY   : 93.7
CLOUD COVER         : 0.34

SUNRISE/SUNSET      : 6 8

END OF RUN
```

2015 Scenario File: Mobile6 Output File (VIGO2015.TXT)

```
****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                               *
* Input file: C:\WEST\WEST.IN (file 1, run 1).                             *
****************************************************************************

 M603 Comment:
        User has disabled the calculation of REFUELING emissions.


* Reading Registration Distributions from the following external
* data file: C:\WEST\REGDATA.D
 M 49 Warning:
         1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
         1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
         1.00    MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: C:\WEST\2011FVMT.DEF

  Reading User Supplied ROADWAY VMT Factors

* Reading Hourly VMT distribution from the following external
* data file: C:\WEST\HVMT.DEF

* Reading Hourly, Roadway, and Speed VMT dist. from the following external
* data file: C:\WEST\2011SVMT.DEF

* #########################
* Scenario Title : west County 2002
* File 1, Run 1, Scenario 1.
* #########################
 M617 Comment:
        User supplied alternate AC input: Cloud Cover Fraction set to 0.34
 M618 Comment:
        User supplied alternate AC input: Sunrise at  6 AM, Sunset at  8 PM.
 M 48 Warning:
        there are no sales for vehicle class HDGV8b
 M 48 Warning:
        there are no sales for vehicle class LDDT12

            Calendar Year: 2015
                    Month: July
                 Altitude: Low
      Minimum Temperature: 65.0 (F)
      Maximum Temperature: 87.3 (F)
        Absolute Humidity: 94. grains/lb
         Nominal Fuel RVP:  7.0 psi
           Weathered RVP:  6.9 psi
      Fuel Sulfur Content:  30. 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:	0.2937	0.4156	0.1569		0.0370	0.0003	0.0023	0.0889	0.0054	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.548	0.535	0.688	0.577	0.466	0.121	0.223	0.264	2.05	0.544
Composite CO :	7.92	8.25	9.17	8.51	7.24	0.771	0.465	0.727	16.13	7.615
Composite NOX :	0.431	0.494	0.643	0.534	1.174	0.249	0.362	3.533	1.21	0.798

2020 Scenario File: Mobile6 Input File (VIGO2020.IN)

```
MOBILE6 INPUT FILE :

POLLUTANTS          : HC CO NOx
REPORT FILE         : VIGO2020.txt

RUN DATA

MIN/MAX TEMP        : 65. 87.3
FUEL RVP            : 7.0
EXPRESS HC AS VOC   :
NO REFUELING        :
REG DIST            : C:\Mobile6\Vigo\Regdata.d
VMT BY FACILITY     : C:\Mobile6\Vigo\2020FVMT.def
VMT BY HOUR         : C:\Mobile6\Vigo\HVMT.def
SPEED VMT           : C:\Mobile6\Vigo\2020SVMT.def

SCENARIO RECORD     : Scenario Title : Vigo County 2020

CALENDAR YEAR       : 2020
EVALUATION MONTH    : 7

ABSOLUTE HUMIDITY   : 93.7
CLOUD COVER         : 0.34

SUNRISE/SUNSET      : 6 8

END OF RUN
```

2020 Scenario File: Mobile6 Output File (VIGO2020.TXT)

```
******************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                     *
* Input file: C:\WEST\WEST.IN (file 1, run 1).                   *
******************************************************************

 M603 Comment:
        User has disabled the calculation of REFUELING emissions.

* Reading Registration Distributions from the following external
* data file: C:\WEST\REGDATA.D
 M 49 Warning:
          1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
          1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
          1.00    MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: C:\WEST\2011FVMT.DEF

 Reading User Supplied ROADWAY VMT Factors

* Reading Hourly VMT distribution from the following external
* data file: C:\WEST\HVMT.DEF

* Reading Hourly, Roadway, and Speed VMT dist. from the following external
* data file: C:\WEST\2011SVMT.DEF

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* Scenario Title : west County 2002
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
 M617 Comment:
        User supplied alternate AC input: Cloud Cover Fraction set to 0.34.
 M618 Comment:
        User supplied alternate AC input: Sunrise at 6 AM, Sunset at 8 PM.
 M 48 Warning:
        there are no sales for vehicle class HDGV8b
 M 48 Warning:
        there are no sales for vehicle class LDDT12

            Calendar Year: 2020
                    Month: July
                 Altitude: Low
      Minimum Temperature: 65.0 (F)
      Maximum Temperature: 87.3 (F)
        Absolute Humidity: 94. grains/lb
         Nominal Fuel RVP: 7.0 psi
           Weathered RVP: 6.9 psi
      Fuel Sulfur Content: 30. 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:	0.2898	0.4320	0.1630		0.0374	0.0002	0.0024	0.0898	0.0053	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.404	0.413	0.544	0.449	0.315	0.071	0.158	0.234	2.05	0.420
Composite CO :	6.92	7.33	8.23	7.57	6.98	0.663	0.393	0.422	16.13	6.756
Composite NOX :	0.306	0.378	0.510	0.413	0.631	0.091	0.232	1.798	1.21	0.520

2030 Scenario File: Mobile6 Input File

```
MOBILE6 INPUT FILE :

POLLUTANTS          : HC CO NOx
REPORT FILE         : VIGO2030.txt

RUN DATA

MIN/MAX TEMP        : 65. 87.3
FUEL RVP            : 7.0
EXPRESS HC AS VOC   :
NO REFUELING        :
REG DIST            : C:\Mobile6\Vigo\Regdata.d
VMT BY FACILITY     : C:\Mobile6\Vigo\2030FVMT.def
VMT BY HOUR         : C:\Mobile6\Vigo\HVMT.def
SPEED VMT           : C:\Mobile6\Vigo\2030SVMT.def

SCENARIO RECORD     : Scenario Title : Vigo County 2030

CALENDAR YEAR       : 2030
EVALUATION MONTH    : 7

ABSOLUTE HUMIDITY   : 93.7
CLOUD COVER         : 0.34

SUNRISE/SUNSET      : 6 8

END OF RUN
```

2030 Scenario File: Mobile6 Output File (VIGO2030.TXT)

```
****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                               *
* Input file: C:\WEST\WEST.IN (file 1, run 1).                             *
****************************************************************************
 M603 Comment:
        User has disabled the calculation of REFUELING emissions.


* Reading Registration Distributions from the following external
* data file: C:\WEST\REGDATA.D
 M 49 Warning:
        1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
        1.00    MYR sum not = 1. (will normalize)
 M 49 Warning:
        1.00    MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: C:\WEST\2011FVMT.DEF

 Reading User Supplied ROADWAY VMT Factors

* Reading Hourly VMT distribution from the following external
* data file: C:\WEST\HVMT.DEF

* Reading Hourly, Roadway, and Speed VMT dist. from the following external
* data file: C:\WEST\2011SVMT.DEF

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* Scenario Title : west County 2002
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
 M617 Comment:
        User supplied alternate AC input: Cloud Cover Fraction set to 0.34.
 M618 Comment:
        User supplied alternate AC input: Sunrise at  6 AM, Sunset at  8 PM.
 M 48 Warning:
        there are no sales for vehicle class HDGV8b
 M 48 Warning:
        there are no sales for vehicle class LDDT12

           Calendar Year:  2030
                   Month:  July
                Altitude:  Low
     Minimum Temperature:  65.0 (F)
     Maximum Temperature:  87.3 (F)
       Absolute Humidity:  94. grains/lb
      Nominal Fuel RVP:  7.0 psi
         Weathered RVP:  6.9 psi
     Fuel Sulfur Content:  30. 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:	0.2698	0.4320	0.1630		0.0374	0.0002	0.0024	0.0898	0.0055	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.344	0.372	0.429	0.387	0.222	0.048	0.100	0.212	2.05	0.362
Composite CO :	6.51	7.00	7.51	7.14	6.77	0.595	0.321	1.235	16.13	6.367
Composite NOX :	0.250	0.329	0.416	0.353	0.200	0.032	0.139	0.677	1.21	0.352