

ACTIVITY 2.C

EMISSIONS AND THE EPA

OUTCOMES

By the end of this activity students should come to their own conclusions on what success the EPA has had in improving the quality of the air we breath by mandating reductions in car emissions. They will do this by:

- Constructing, reading and interpreting charts of emission data.
- Analyzing these charts to determine the effectiveness of emission control standards.
- Reporting on their findings to the class.

TIME REQUIRED

- 45 minutes, follow-up discussion as needed

MATERIALS

For each group:

- A data analysis pack. Each pack should pertain to a specific pollutant and contain:
 - Copied onto transparency film or tracing paper:
 1. blank chart of average emissions per car
 2. blank chart of total emissions for all cars
 - Copied onto white paper:
 1. chart of EPA emission standards
 2. blank chart of annual miles driven for all cars
 - For each student in the group:
 - 1 data set
 - 1 worksheet
- 2 different colored markers for drawing on the transparency film or tracing paper.

Note: Using tracing paper will allow students to use an overhead projector to share their findings with the class.

TEACHER PREPARATION

Copy the supplied blank charts onto transparency film.

Compile the data analysis packets.

ACTIVITY OVERVIEW

The Environmental Protection Agency was created in 1970 in response to wide spread public concern for the environment. As part of its mandate by congress, the EPA was assigned responsibility for regulating motor vehicle pollution. It has done this by setting emission standards for individual vehicles.

In this activity students will see that the standards set by the EPA have successfully decreased the emissions from individual vehicles. However, the students will also see that the number of vehicles has escalated, as has the aver-

age annual number of miles driven per vehicle. The net result is that the total emissions are being reduced at a slower rate than expected and, in some cases are actually increasing. The end result is that automobile emissions continue to be a major contributor to poor air quality in much of our country.

You may want to end this activity by asking students what they think they can do as individuals to improve the quality of the air we breath. Such a discussion will lead into the next two lessons where students explore the potentials of carpooling and/or using mass transit.

ACTIVITY

Divide the class into working groups. Give each group a data analysis pack relating to one specific automobile emission, CO₂, CO, VOC, NO_x, Particulates or Lead (Pb). These are among the emissions researched in activity 2A. Depending upon class and group size, groups may or may not be working with the same data.

Have each group divide the tasks of creating bar charts for (1) Average Emissions per Car on the grams/mile chart, (2) Total Emissions of All Cars on the million tons/year chart, and (3) Total Miles Driven by all Cars on the miles/year chart. Have them use different colors for each chart.

Ask each group to overlay the first two graphs on the EPA Emissions Standards chart. The x-axis of each chart should line up. Have the groups discuss the charts and have each student complete the first side of their worksheet.

Ask each group to present their charts and their interpretation of the data to the class. If charts are on transparency film have each group display their charts with an overhead projector. You may also wish to ask each group to summarize the adverse effects of the emission they are reporting on.

As each group presents their information have all students record summaries for each pollutant on the second page of their worksheets.

Suggested Review Questions:

- Would the EPA be pleased with these results?
- What are some other strategies the EPA could implement in their effort to preserve air quality?
- What can you do as an individual to help improve the quality of our air?

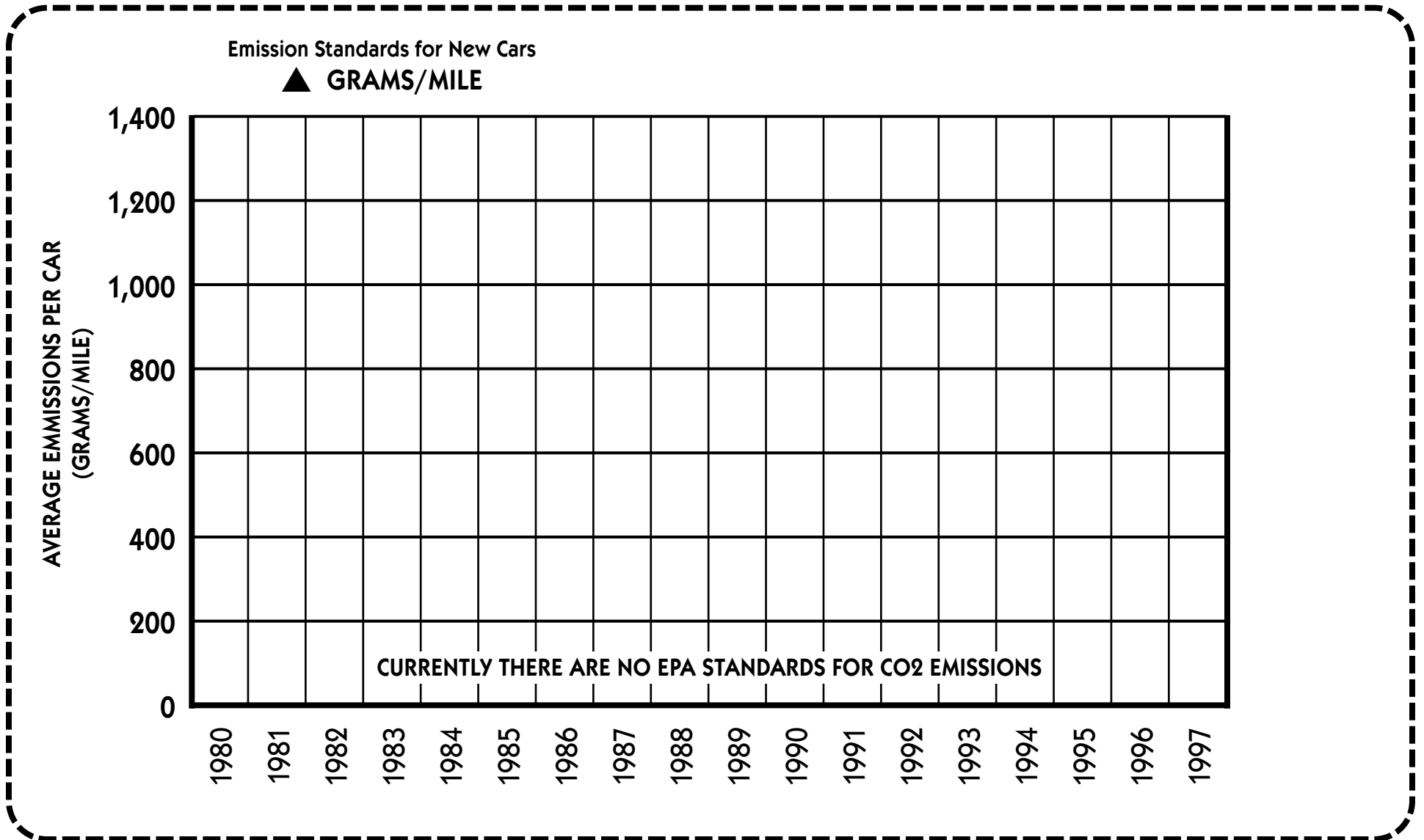
Carbon Dioxide (CO₂) Data Set

YEAR	EMISSION STANDARDS FOR NEW CARS (grams/mile)	AVERAGE EMISSIONS OF ALL CARS IN USE (grams/mile)	TOTAL MILES DRIVEN IN ONE YEAR BY ALL CARS IN USE (billion miles)	TOTAL EMISSIONS IN ONE YEAR FROM ALL CARS IN USE (million tons)
1980	N/A	572	1,527	962
1985	N/A	506	1,774	991
1990	N/A	446	2,144	1,055
1993	N/A	425	2,296	1,077
1994	N/A	426	2,357	1,108
1995	N/A	424	2,422	1,131
1996	N/A	424	2,485	1,159
1997	N/A	413	2,560	1,165

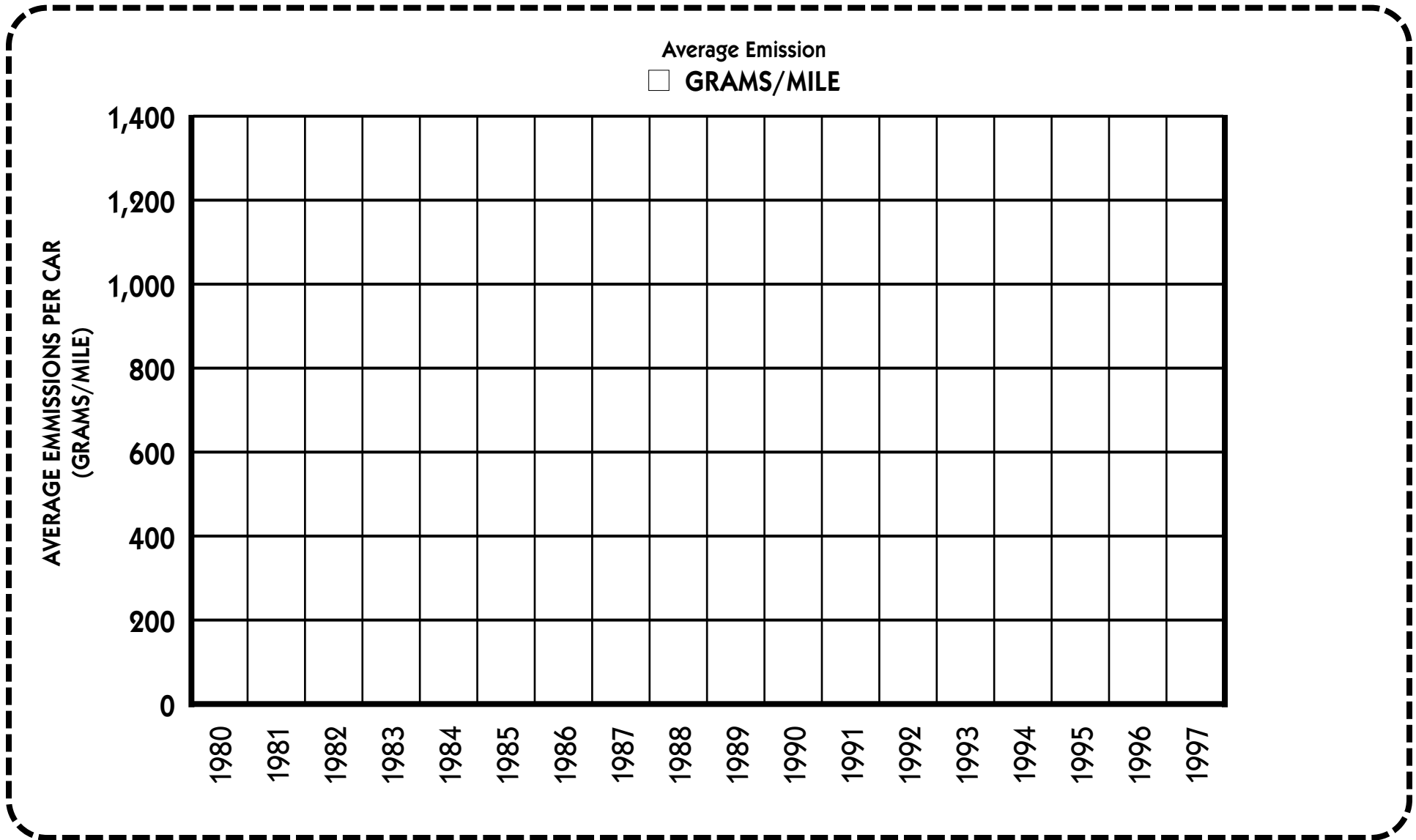
Currently there are no emission standards for CO₂.

Source: Transportation Energy Data Book: Edition 19. 1999.
Stacy C. Davis. Oak Ridge National Laboratory

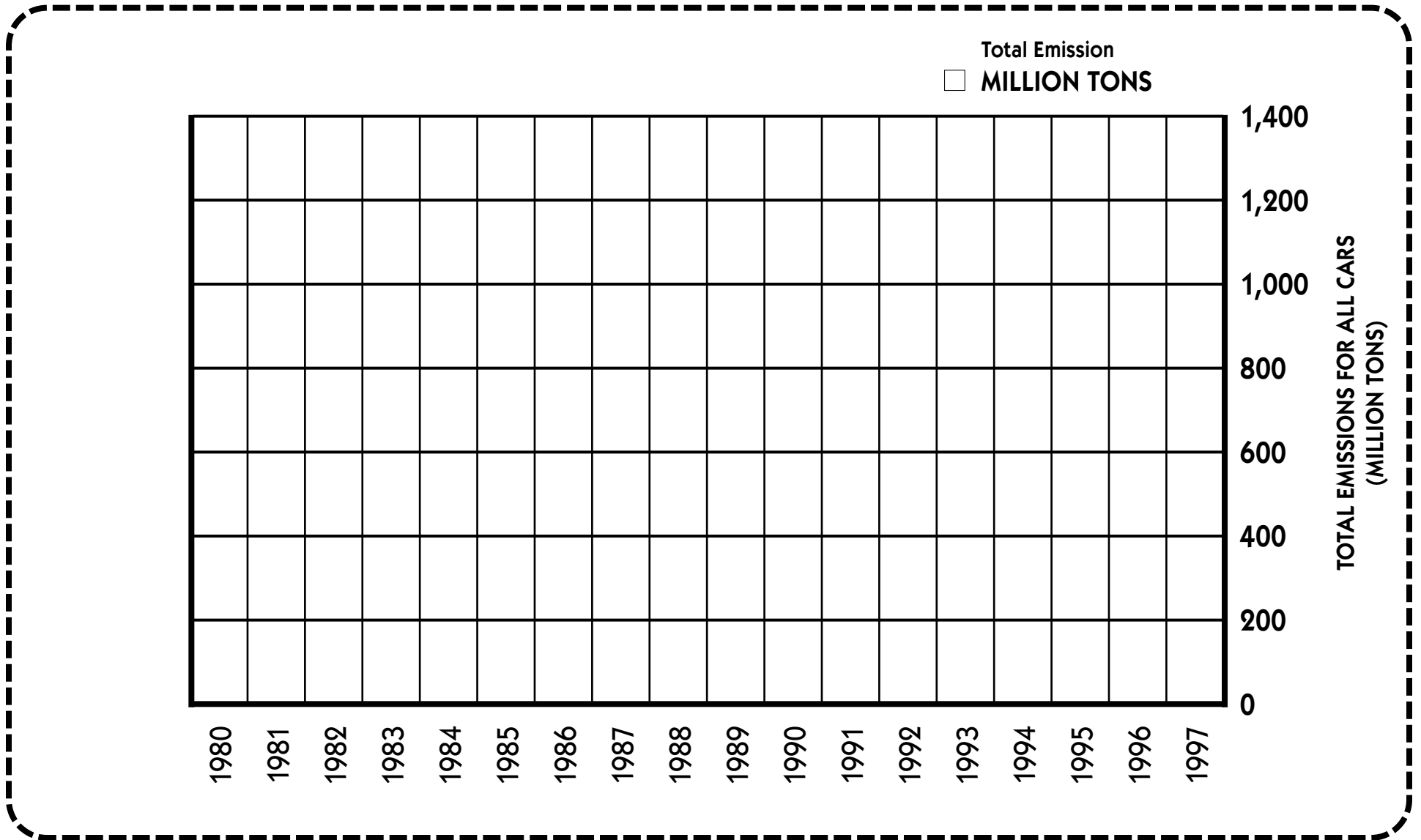
CO2 Emission Standards for New Cars



CO2 Average Emission for Cars on the Road



CO₂ Total Emissions for All Cars

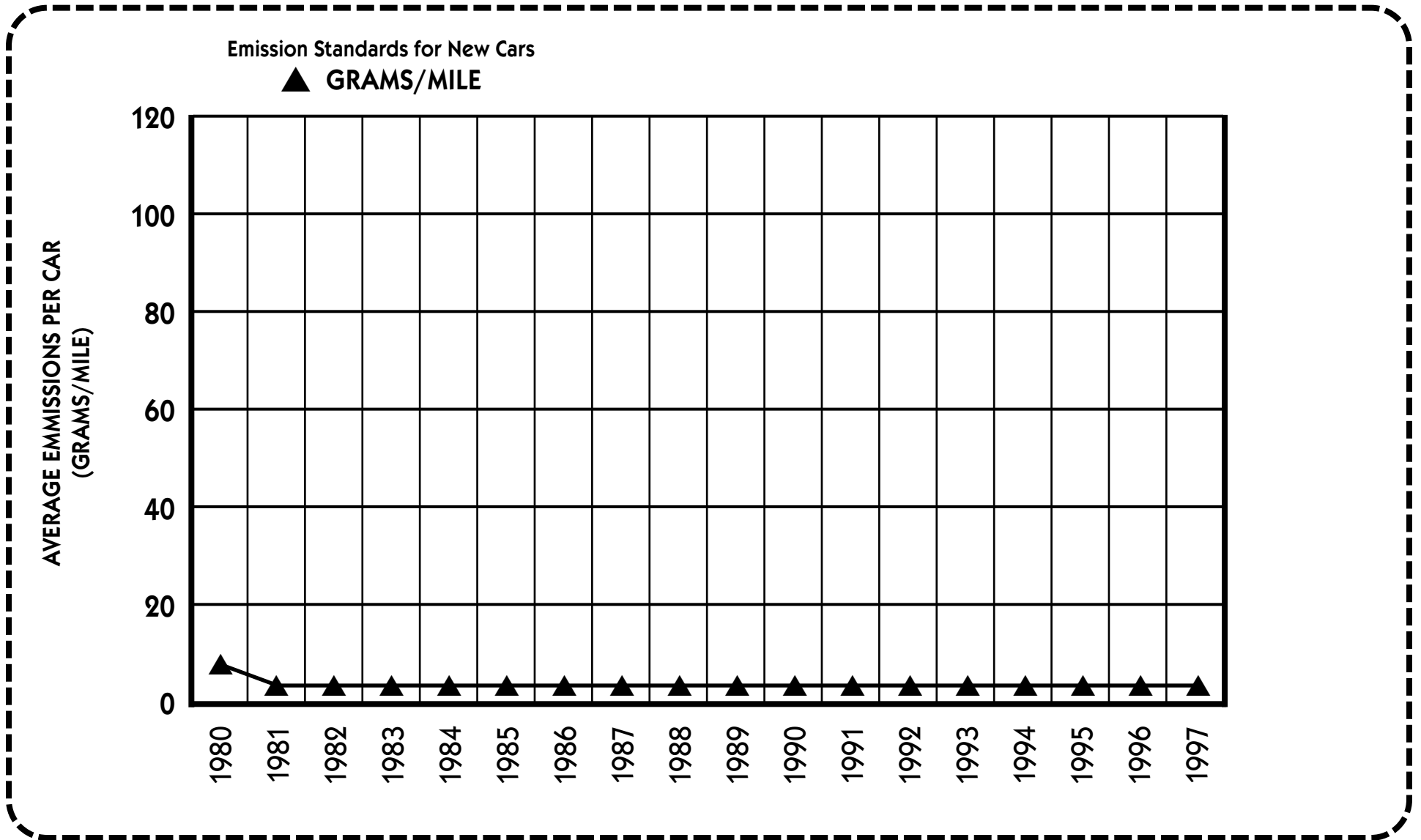


Carbon Monoxide (CO) Data Set

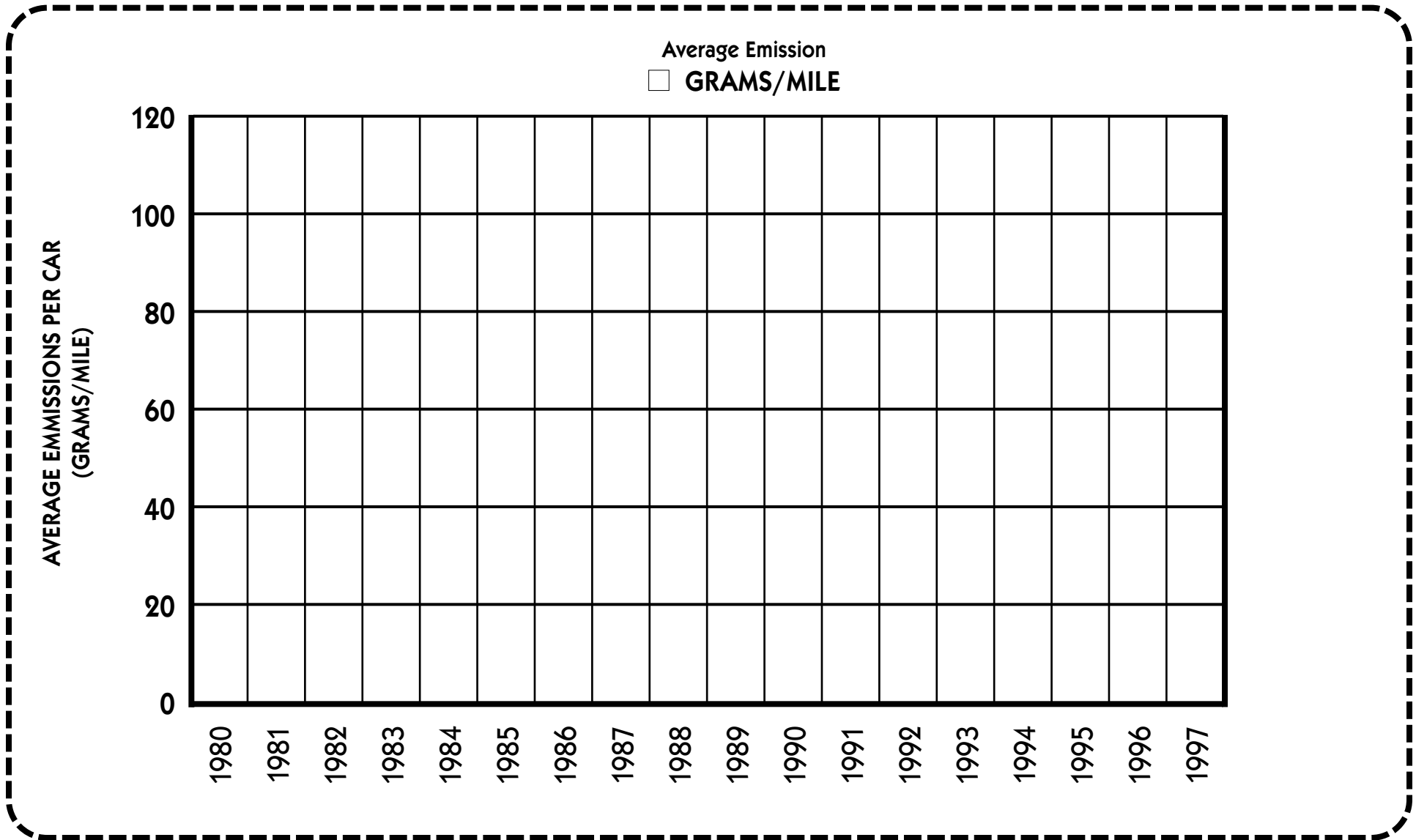
YEAR	EMISSION STANDARDS FOR NEW CARS (grams/mile)	AVERAGE EMISSIONS OF ALL CARS IN USE (grams/mile)	TOTAL MILES DRIVEN IN ONE YEAR BY ALL CARS IN USE (billion miles)	TOTAL EMISSIONS IN ONE YEAR FROM ALL CARS IN USE (million tons)
1980	7	46.4	1,527	873
1985	3.4	39.6	1,774	899
1990	3.4	24.5	2,144	957
1993	3.4	23.8	2,296	977
1994	3.4	23.6	2,357	1,005
1995	3.4	20.3	2,422	1,026
1996	3.4	19.4	2,485	1,052
1997	3.4	17.8	2,560	1,057

Source: Transportation Energy Data Book: Edition 19. 1999.
Stacy C. Davis. Oak Ridge National Laboratory

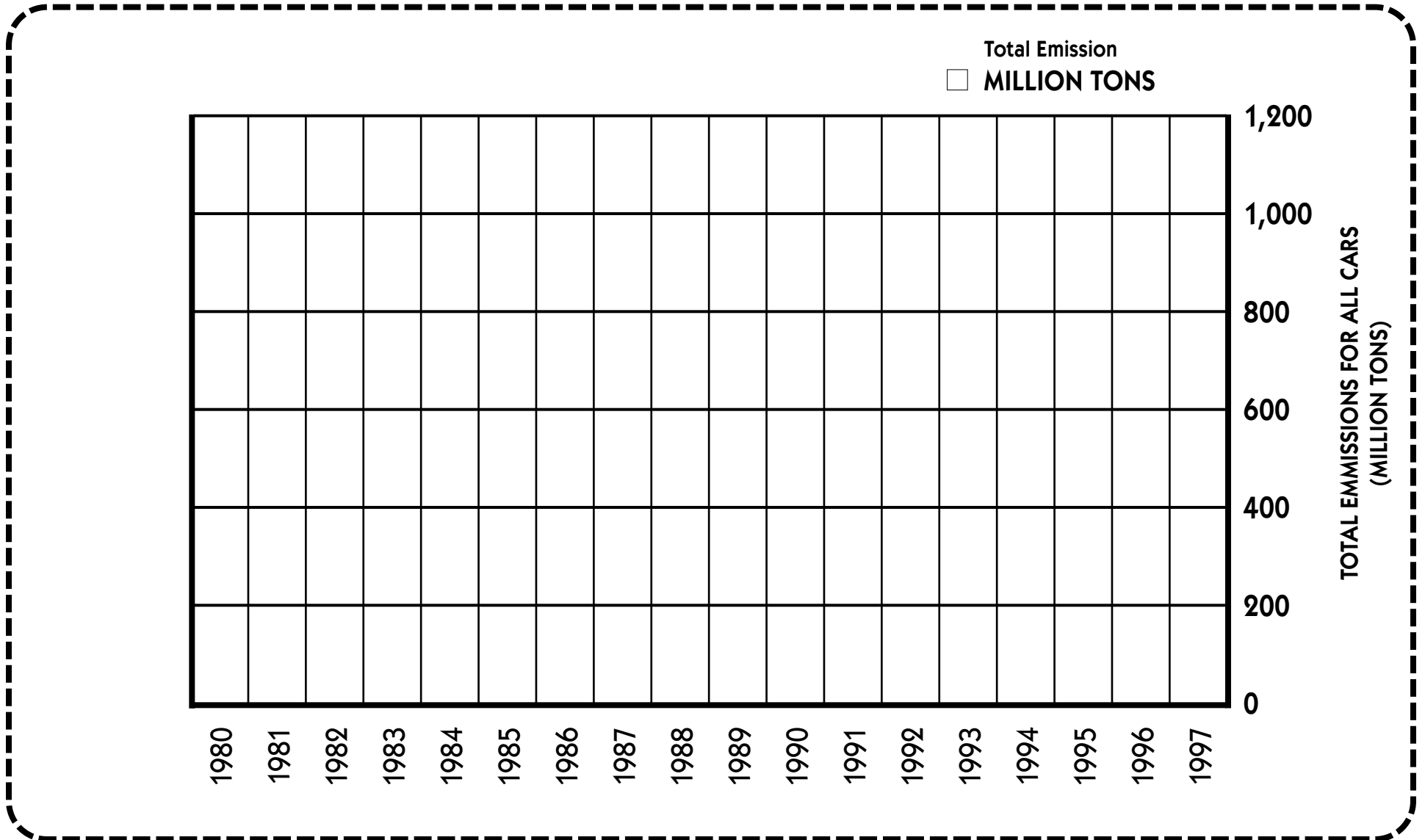
CO Emission Standards for New Cars



CO Average Emission for Cars on the Road



CO Total Emissions for All Cars

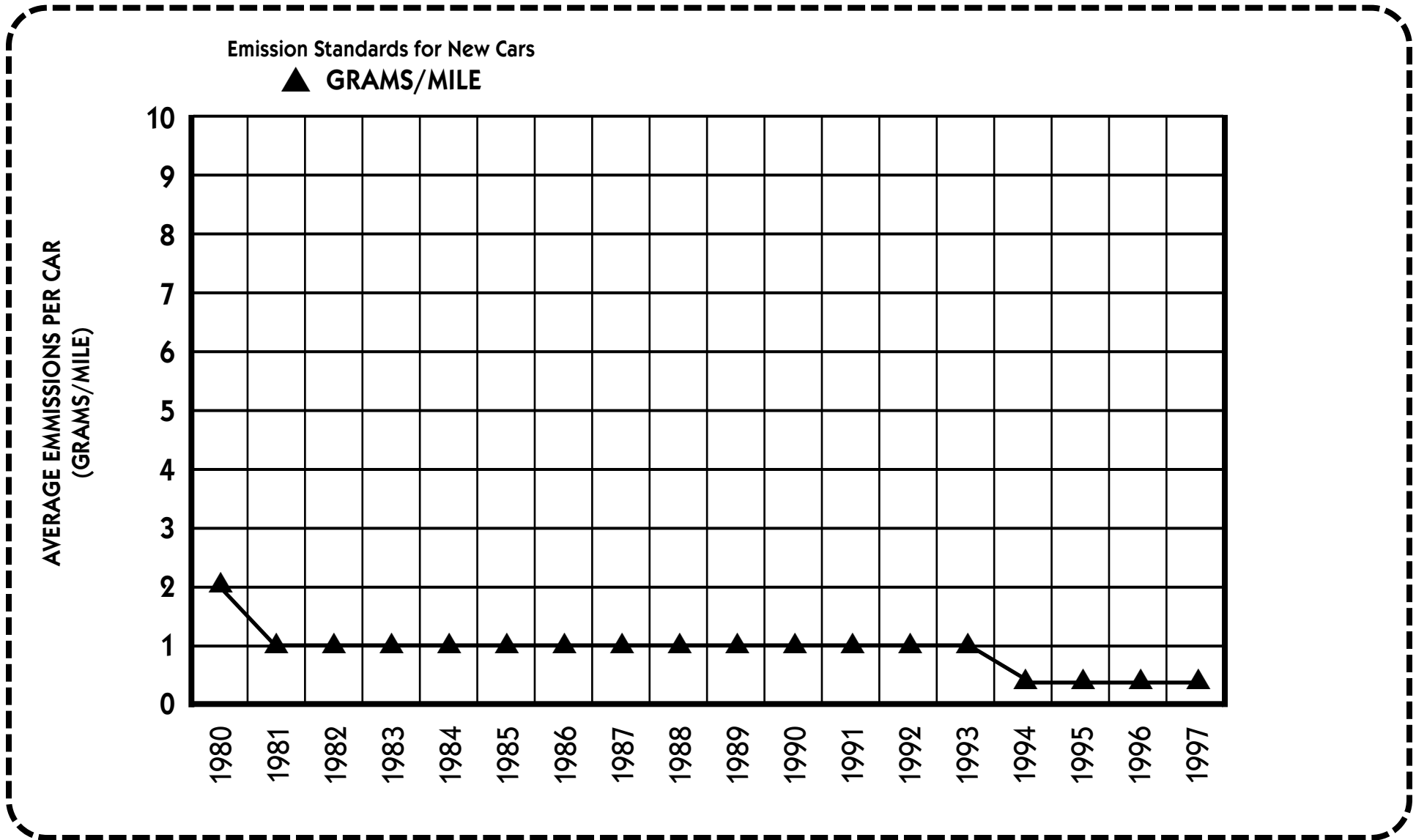


Nitrogen Oxides (NO_x) Data Set

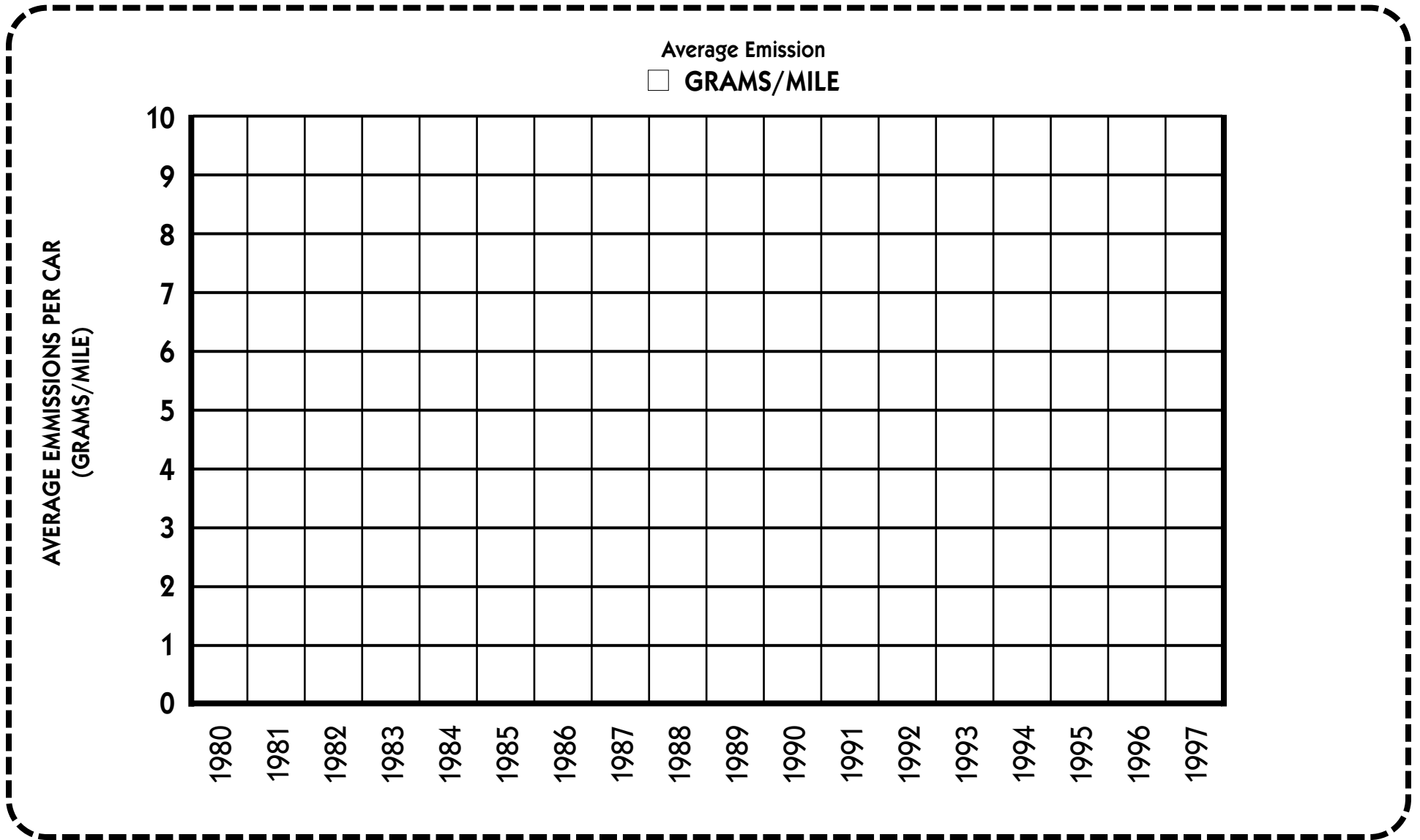
YEAR	EMISSION STANDARDS FOR NEW CARS (grams/mile)	AVERAGE EMISSIONS OF ALL CARS IN USE (grams/mile)	TOTAL MILES DRIVEN IN ONE YEAR BY ALL CARS IN USE (billion miles)	TOTAL EMISSIONS IN ONE YEAR FROM ALL CARS IN USE (million tons)
1980	2	5.1	1,527	8.6
1985	1	4.1	1,774	8.1
1990	1	3.0	2,144	7.0
1993	1	3.0	2,296	7.5
1994	0.4	3.0	2,357	7.7
1995	0.4	2.7	2,422	7.3
1996	0.4	2.6	2,485	7.3
1997	0.4	2.5	2,560	7.0

Source: Transportation Energy Data Book: Edition 19. 1999.
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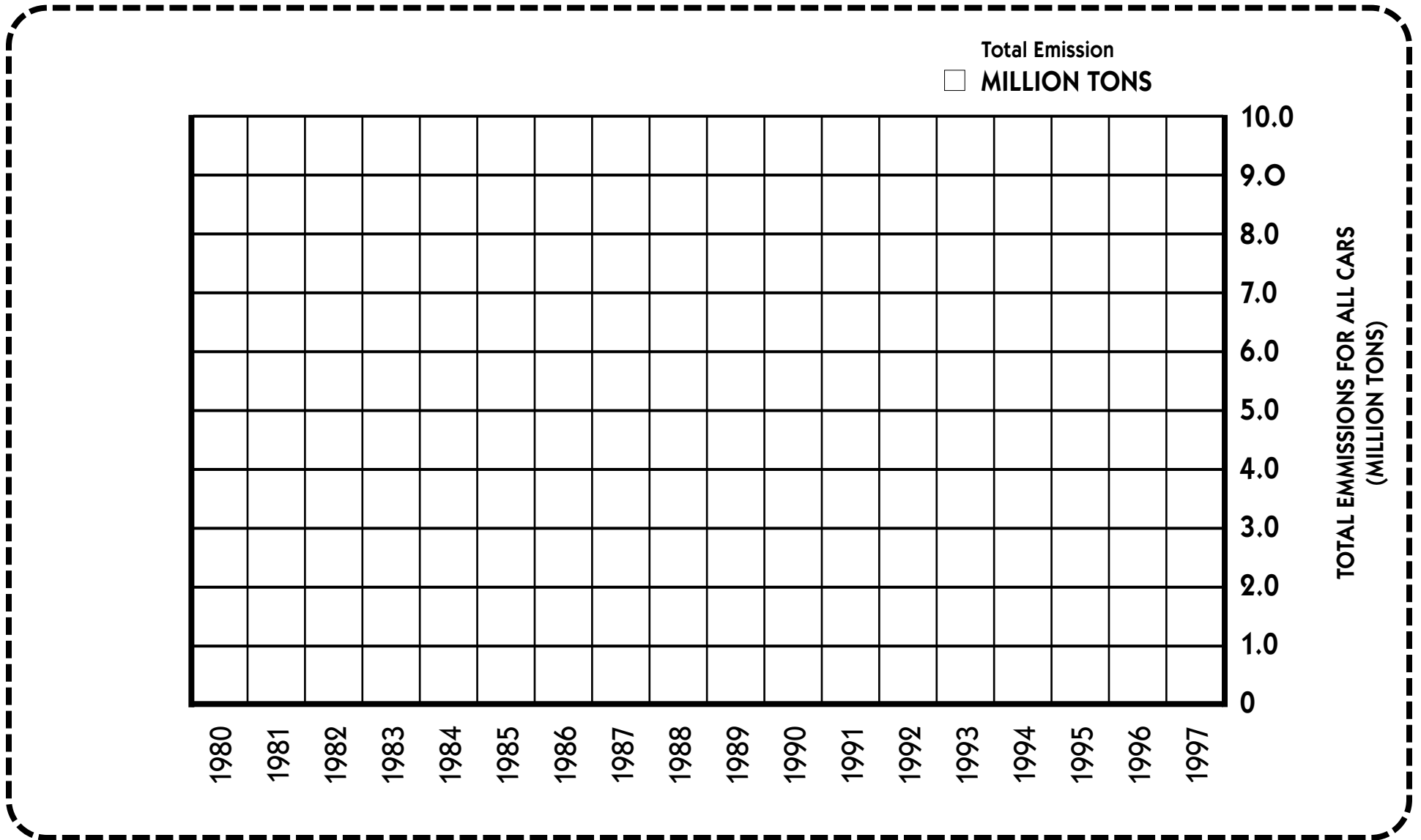
NOx Emission Standards for New Cars



NOx Average Emission for Cars on the Road



NOx Total Emissions for All Cars

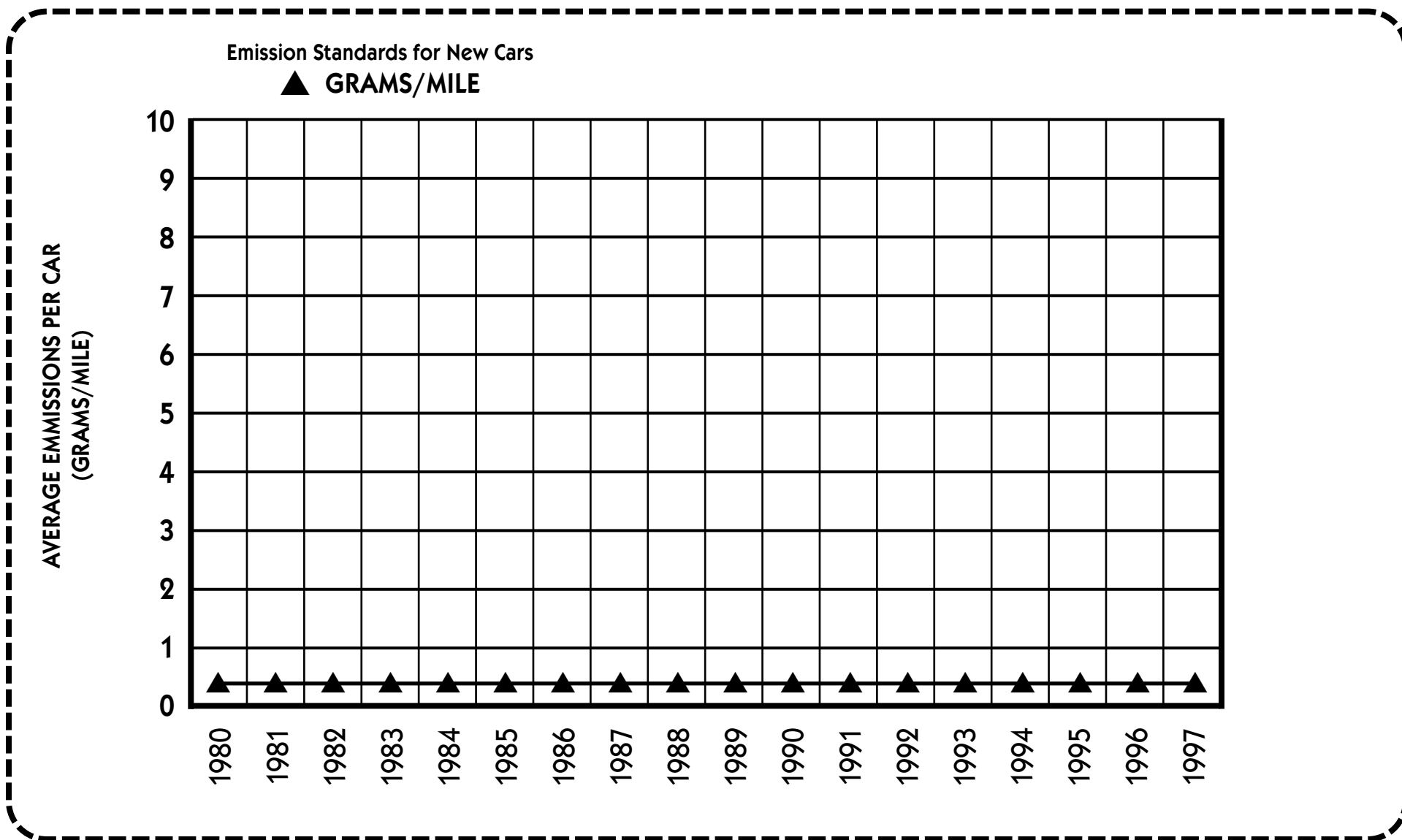


Volatile Organic Compounds (VOC) Data Set

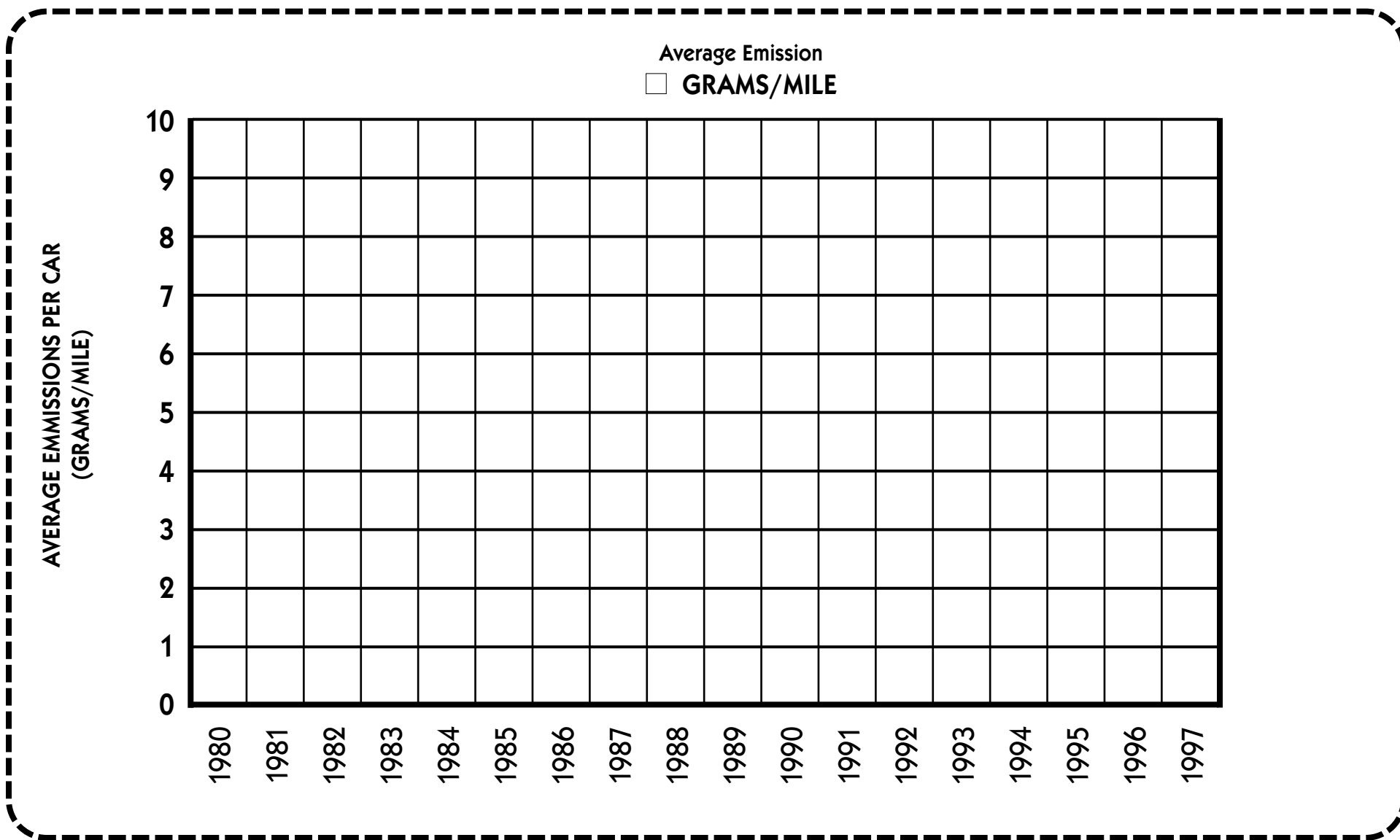
YEAR	EMISSION STANDARDS FOR NEW CARS (grams/mile)	AVERAGE EMISSIONS OF ALL CARS IN USE (grams/mile)	TOTAL MILES DRIVEN IN ONE YEAR BY ALL CARS IN USE (billion miles)	TOTAL EMISSIONS IN ONE YEAR FROM ALL CARS IN USE (million tons)
1980	0.41	5.3	1,527	9.0
1985	0.41	4.8	1,774	9.4
1990	0.41	2.7	2,144	6.3
1993	0.41	2.4	2,296	6.1
1994	0.41	2.5	2,357	6.4
1995	0.41	2.1	2,422	5.7
1996	0.41	2.0	2,485	5.5
1997	0.41	1.9	2,560	5.2

Source: Transportation Energy Data Book: Edition 19. 1999.
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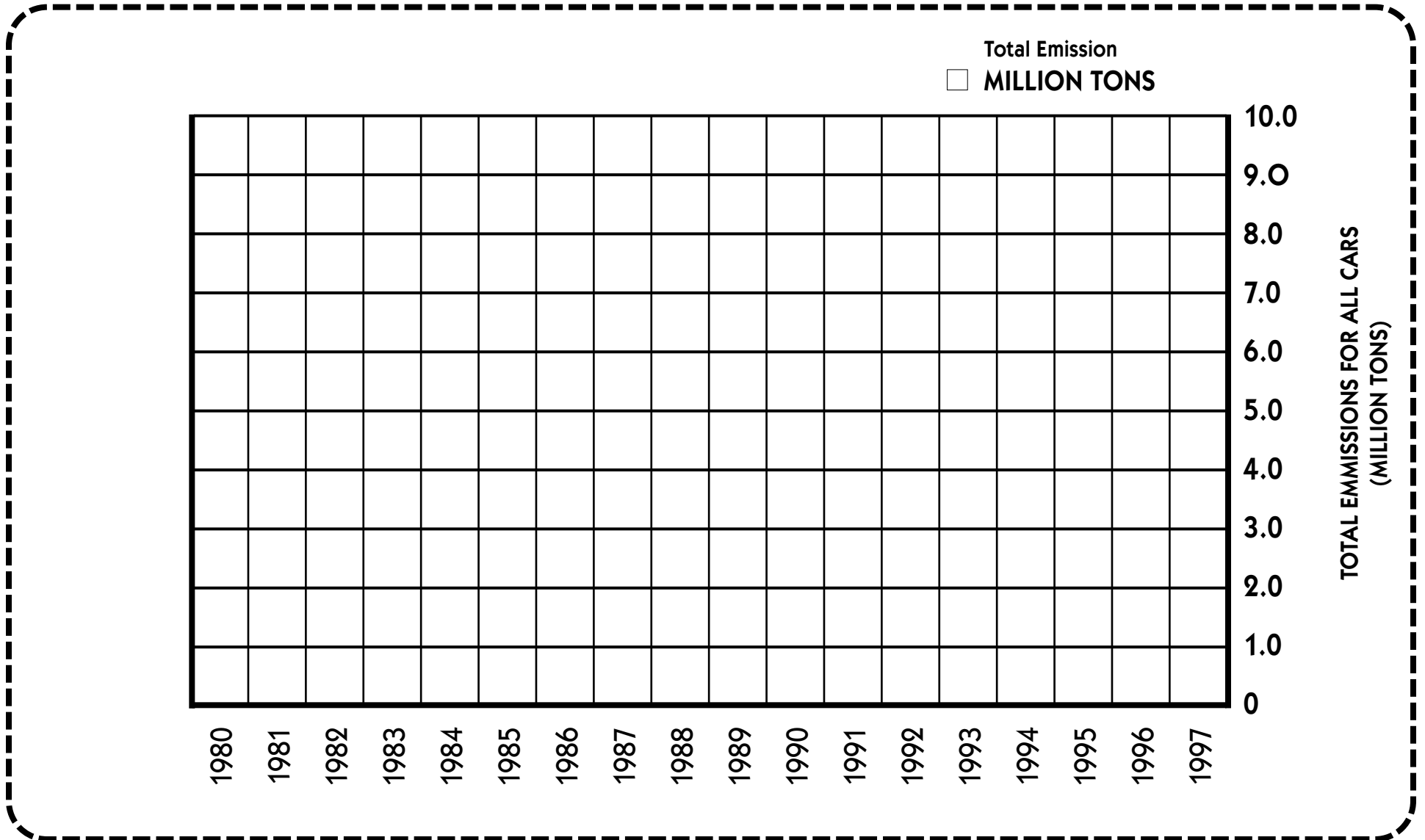
VOC Emission Standards for New Cars



VOC Average Emission for Cars on the Road



VOC Total Emission for All Cars

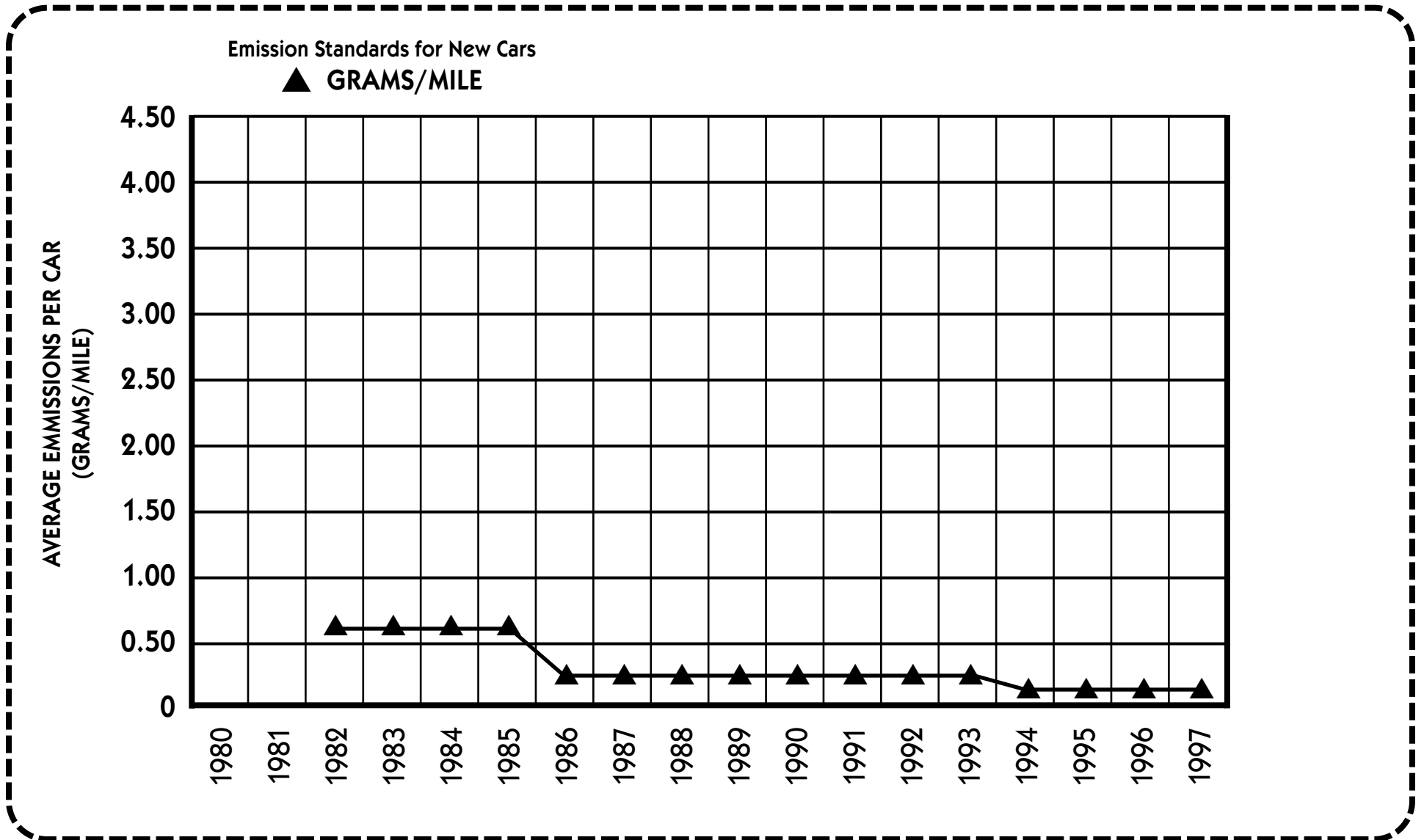


Particulates Data Set

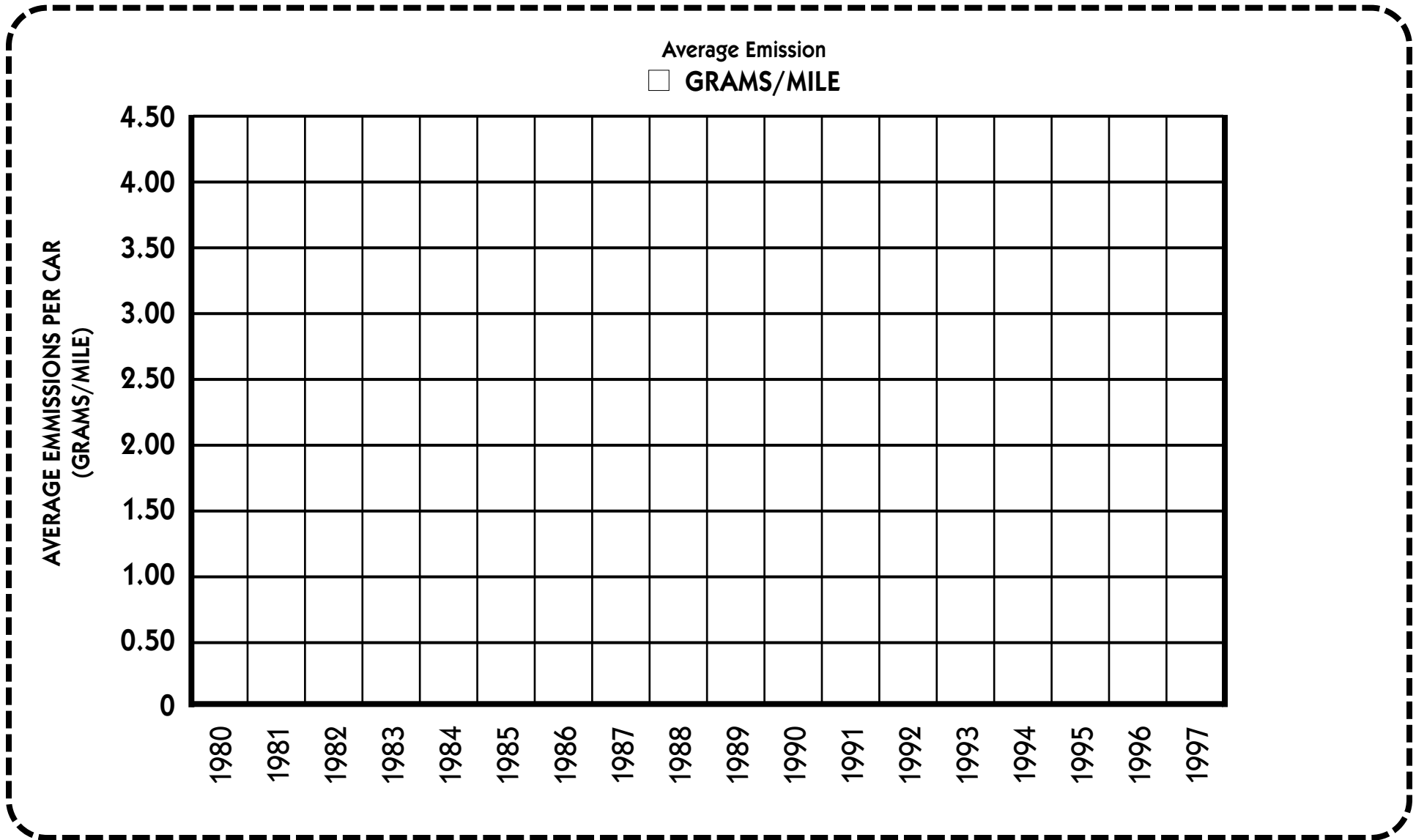
YEAR	EMISSION STANDARDS FOR NEW CARS (grams/mile)	AVERAGE EMISSIONS OF CARS IN USE (grams/mile)	TOTAL MILES DRIVEN IN ONE YEAR BY ALL CARS IN USE (billion miles)	TOTAL EMISSIONS IN ONE YEAR FROM ALL CARS IN USE (million tons)
1980	N/A	0.24	1,527	397
1985	0.6	0.19	1,774	363
1990	0.2	0.14	2,144	336
1993	0.2	0.13	2,296	321
1994	0.08	0.12	2,357	320
1995	0.08	0.11	2,422	293
1996	0.08	0.10	2,485	282
1997	0.08	0.10	2,560	268

Source: Transportation Energy Data Book: Edition 19. 1999.
Stacy C. Davis. Oak Ridge National Laboratory

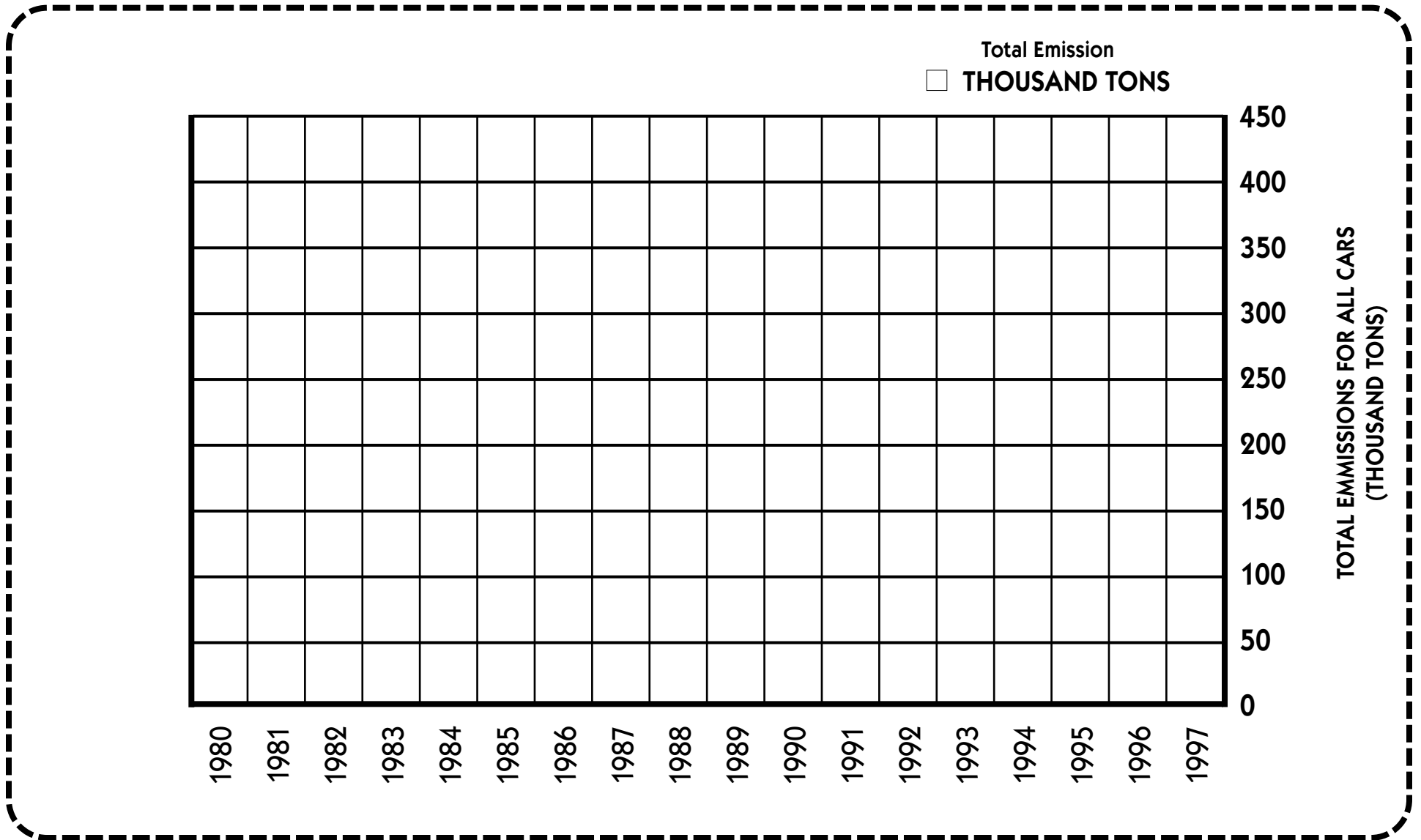
Particulates Emission Standards for New Cars



Particulates Average Emission for Cars on the Road



Particulates Total Emissions for All Cars



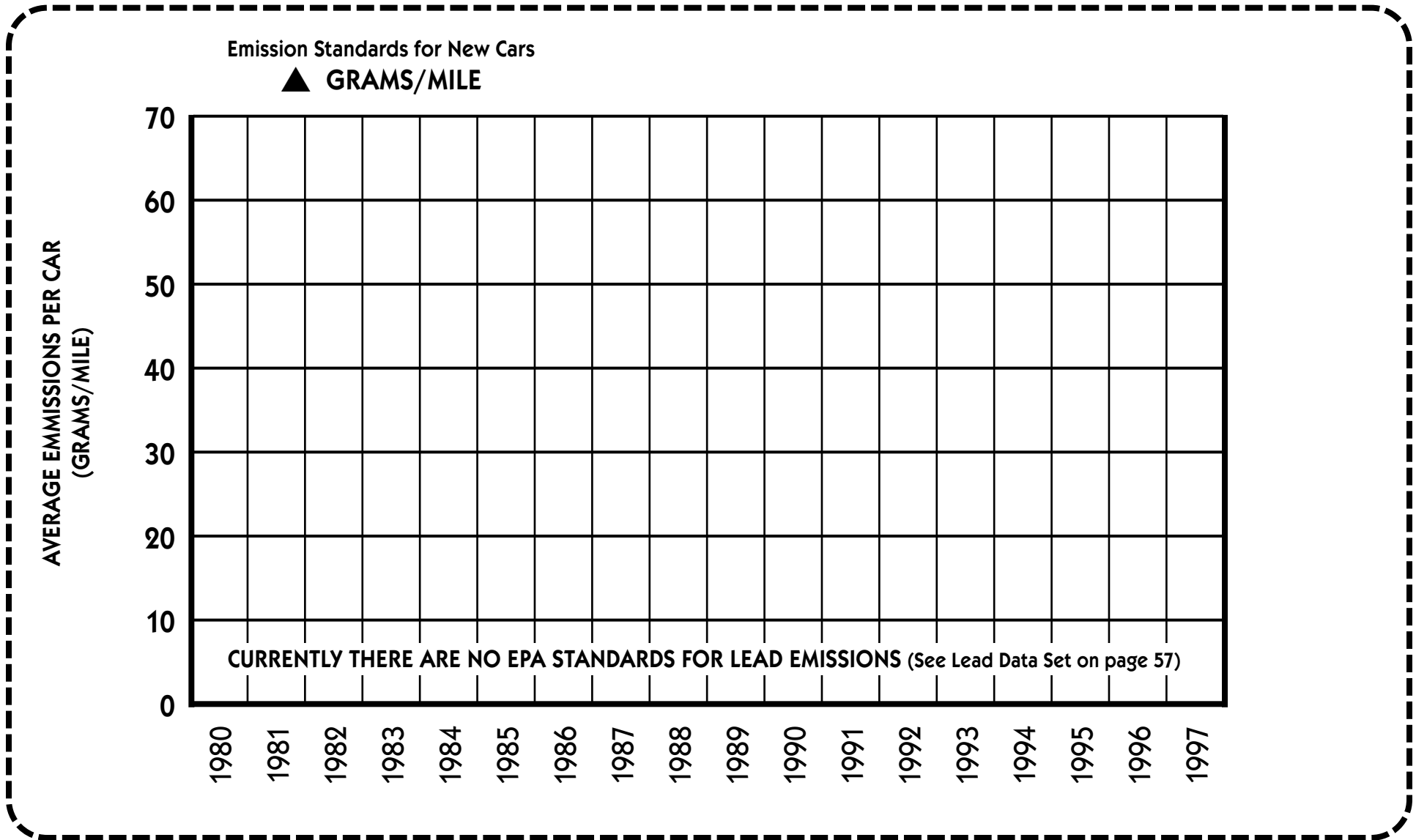
Lead (Pb) Data Set

YEAR	EMISSION STANDARDS FOR NEW CARS (grams/mile)	AVERAGE EMISSIONS OF ALL CARS IN USE (grams/mile)	TOTAL MILES DRIVEN IN ONE YEAR BY ALL CARS IN USE (billion miles)	TOTAL EMISSIONS IN ONE YEAR FROM ALL CARS IN USE (million tons)
1980	N/A	35.9	1,527	60.5
1985	N/A	9.2	1,774	18.1
1990	N/A	0.2	2,144	0.4
1993	N/A	0.0	2,296	0.0
1994	N/A	0.0	2,357	0.0
1995	N/A	0.0	2,422	0.0
1996	N/A	0.0	2,485	0.0
1997	N/A	0.0	2,560	0.0

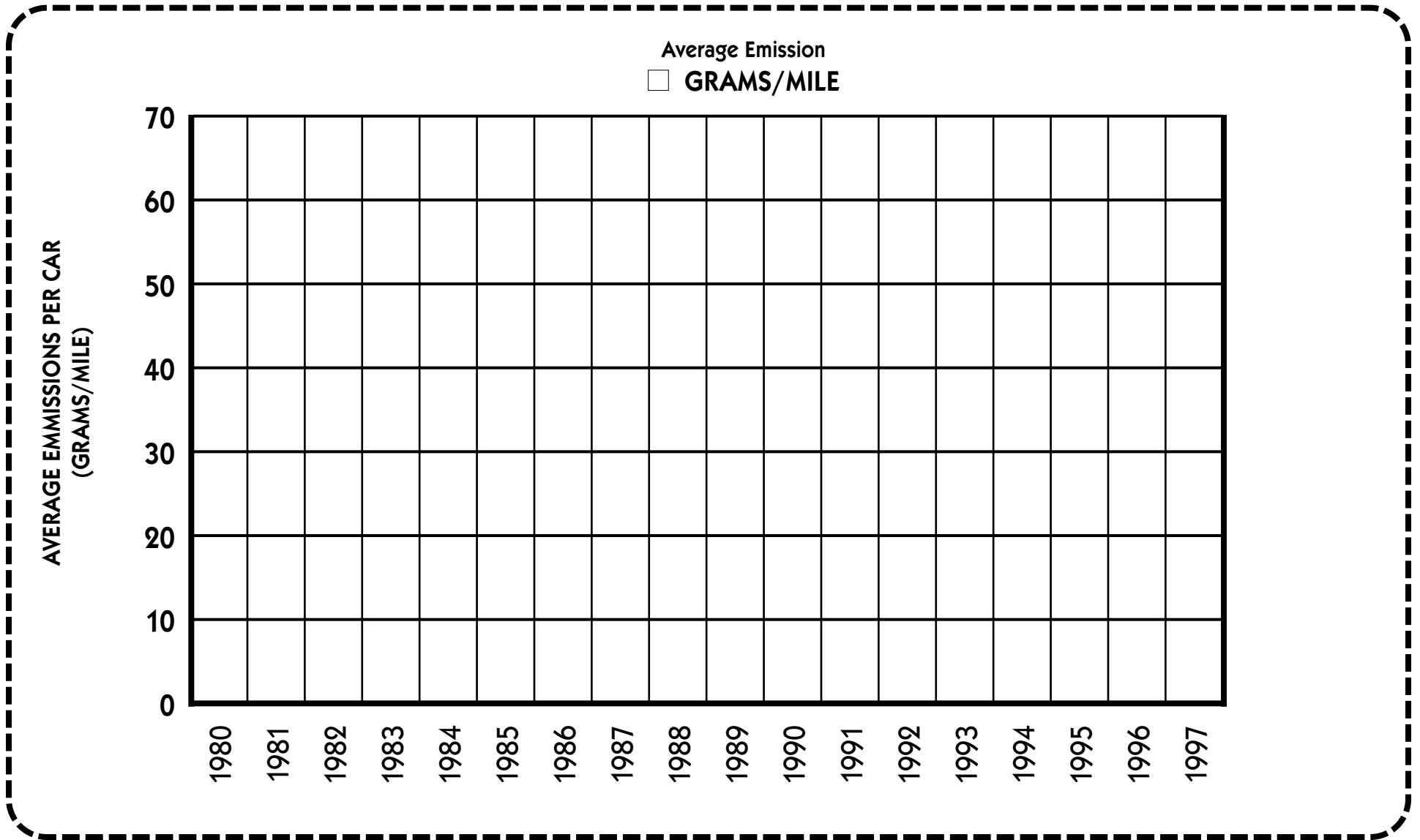
The EPA never established emission standards for lead. Instead, oil refineries were required to supply unleaded gasoline so that catalytic converters could be used to reduce carbon monoxide and VOC emissions.

Source: Transportation Energy Data Book: Edition 19. 1999.
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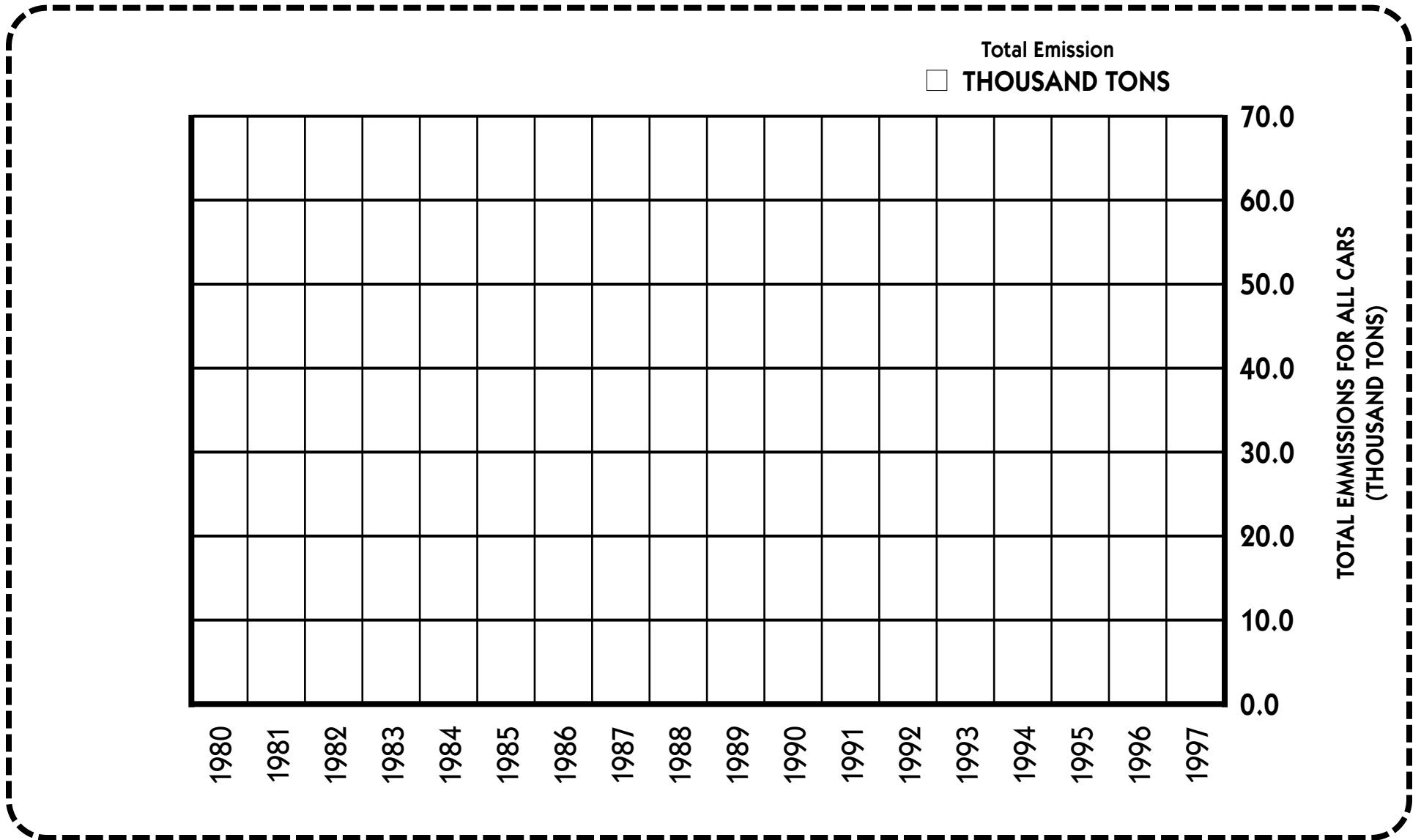
Lead (Pb) Emission Standards for New Cars



Lead (Pb) Average Emission for Cars on the Road



Lead (Pb) Total Emissions for All Cars



Annual Miles Driven by All Cars in Use

