

THE WHITE HOUSE

WASHINGTON

June 10, 1993

MEMORANDUM FOR NEC WORKING GROUP ON THE MOTOR VEHICLE INDUSTRY

FROM: Ellen Seidman 
SUBJECT: Slides from Dan Roos presentation

Enclosed are the slides from Dan Roos' presentation to the NEC working group on the motor vehicle industry today. It was an extremely interesting presentation (particularly the last half), and I'm sorry so many of you missed it. Please let me know as soon as possible if there is another unavoidable conflict, e.g., off-site retreats, on either June 22 or June 29, so I can reschedule Maryann Keller and Dan Luria, respectively.

We will be getting slides from Joel Clark's presentation on life cycle analysis of autos from an environmental perspective soon, and I will pass them along when I receive them.

INTERNATIONAL MOTOR VEHICLE PROGRAM

5 year - 5 million dollar program

Comprehensive - all aspects of manufacturing

Comparative research on world class practice

International benchmarking

Policy forums for senior industry, government and union officials

Coordinated by MIT

The Machine That Changed The World

THE MACHINE THAT CHANGED THE WORLD

Book Acceptance

Hard data to support findings

Systematic perspective

Easy to read

Worldwide impact

English

French

Japanese

Korean

German

Italian

Portuguese

Danish

Spanish

Chinese

Over 300,000 copies sold

Best business book of the year – Financial Times

Auto industry bible

Acceptance by other industries

Critical Success Factors

- **Based on real data**
- **Addressed fundamentals; developed new framework/paradigm for fundamental change in industry**
- **Objectivity extremely important to establish credibility of results**
- **Not just MIT study; brought together best available talent from within and outside MIT**
- **Strong industry participation very important**
- **Brought all stakeholders to the table — industry — government — labor**
- **Real world focus and implementation**

Selected Quotes: Chrysler

Robert Eaton (Chairman), "I always keep in my head the numbers from the MIT book, *The Machine That Changed The World*, for the average hours required to assemble a standardized car: 36 in Europe, 25 in the U.S., 21 for the Japanese in the U.S., and 17 for the Japanese in Japan."

Robert Lutz (Vice Chairman), "Benchmarking is bigger than ever in the auto industry these days, and one big reason why is a landmark book about our industry written three years ago by three professors at MIT. The book was called, *The Machine That Changed The World*, and it introduced a hot new term into the lexicon of American business – 'lean production' ... According to the authors of *The Machine That Changed The World*, the worldwide leaders in lean production were the Japanese, most notably Toyota. Well let me tell you; that the book was a wake-up call for many of us in Detroit.. (I know it was for us at Chrysler.)"

Dennis Pawley (Executive Vice President, Manufacturing), "In my opinion the real impact of *The Machine That Changed The World* was that for the first time in American industrial history, it prompted the attentions and energies within American companies to begin turning away from the precept of mass production. Spurred on by *The Machine That Changed The World* I'm convinced that American companies are actually beginning to replace mass production with a lean production mentality."

What's Wrong?

The Myths

- **Cost Advantage – Japan has lower wage rates**
- **Luck – Japan had fuel efficient cars when the energy crisis came**
- **Japan, Inc. – MITI is orchestrating a massive industrial policy**
- **Uneven Playing Field – the Yen/Dollar exchange rate provides an unfair advantage to Japan**
- **Cultural – cultural differences in Japan allow for more efficient production which cannot be replicated in other countries**
- **Technological – the Japanese are acquiring our technology which they then exploit**
- **U.S. Government – Bureaucracy, excessive regulations**

IMVP Conclusions

- **Best Japanese auto companies have developed a fundamentally different way of making things**
- **These companies have changed the dynamics of international competition**
- **New goals in manufacturing systems – new levels of best practice – combined benefits of craft and mass production**
 - Improved quality**
 - High productivity**
 - Efficiency at low volumes**
 - Production flexibility**
 - Rapid, efficient product development cycle**
 - Product mix diversity**
- **A new lean production paradigm in contrast with the traditional mass production process**
- **The systemic principles are transferable**

Lean Payoffs

- **Less Resources**

- Half the human effort in the factory**
 - A tenth of in-process inventories**
 - Half the factory space**
 - One-eighth the number of suppliers**
 - One-tenth as many dealers**

- **Rapid & Efficient Product Development Cycle**

- Half the engineering effort**
 - Half to two-thirds the development time**

- **Higher Quality Products**

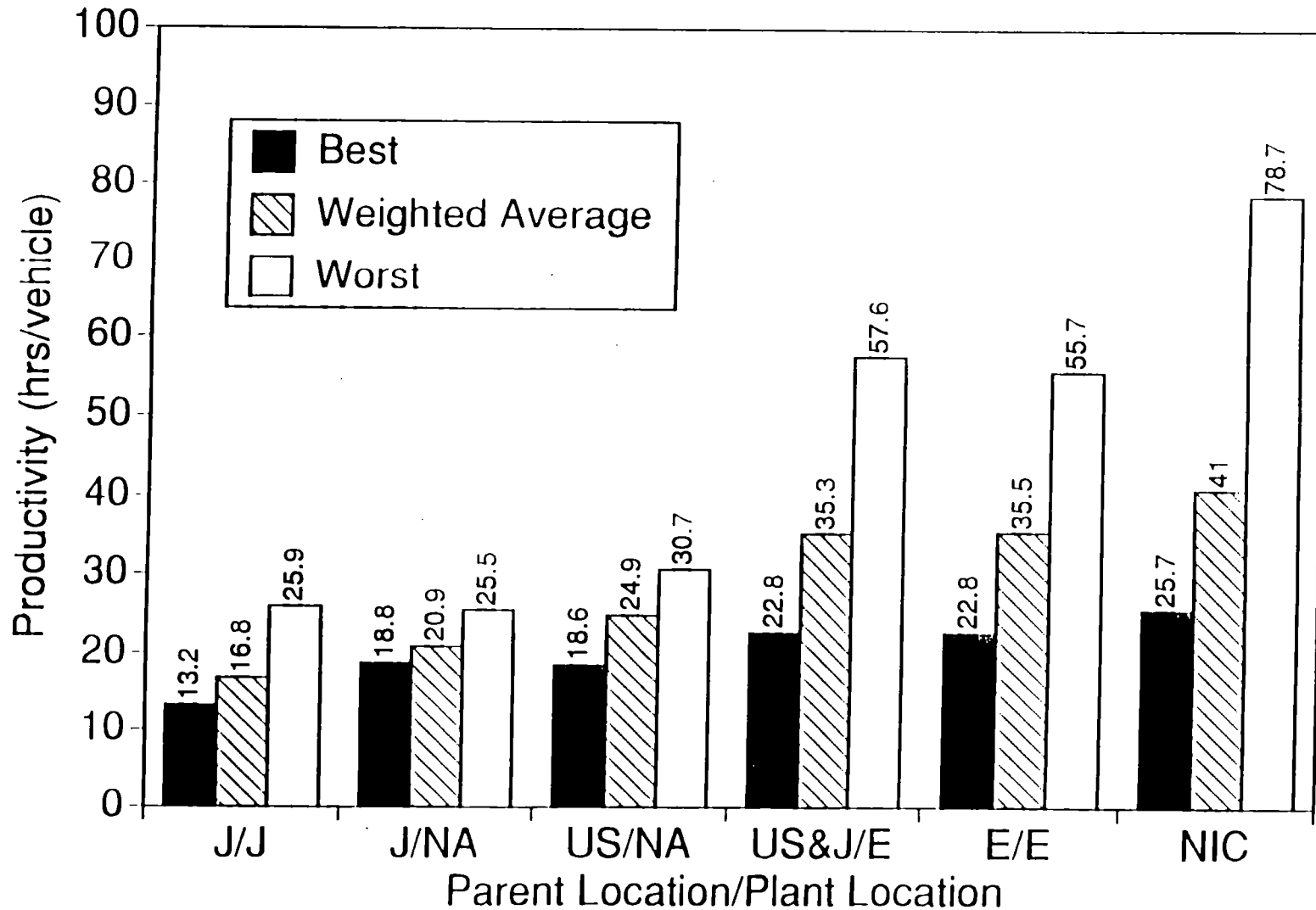
- One-third the defects**

- **Flexibility**

- One-fourth the scale of production**
 - Four times the range of products**

Assembly Plant Productivity, 1989

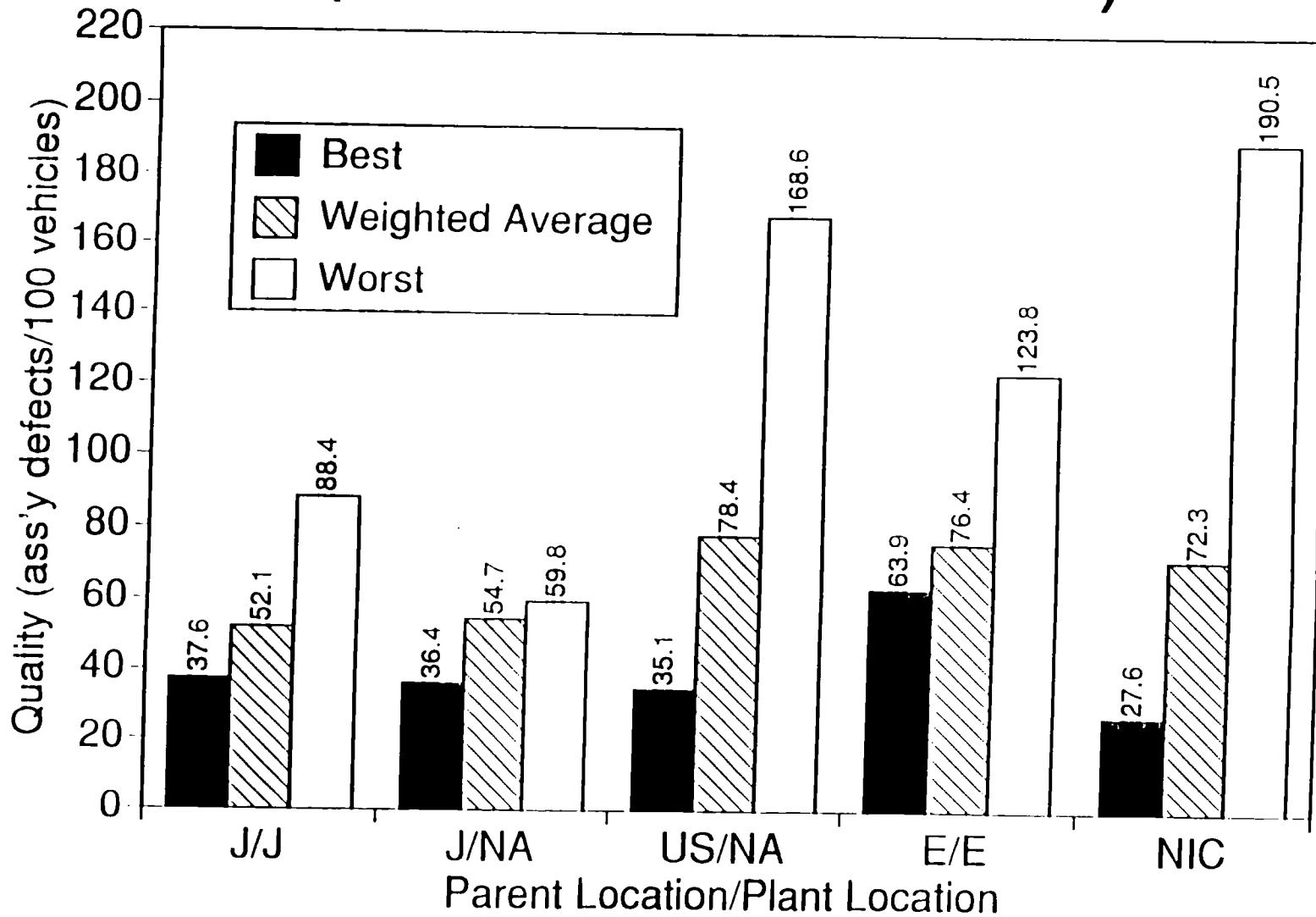
(87 Plants in 17 Countries)



Source: IMVP World Assembly Plant Survey, *The Machine That Changed the World*

Assembly Plant Quality, 1989

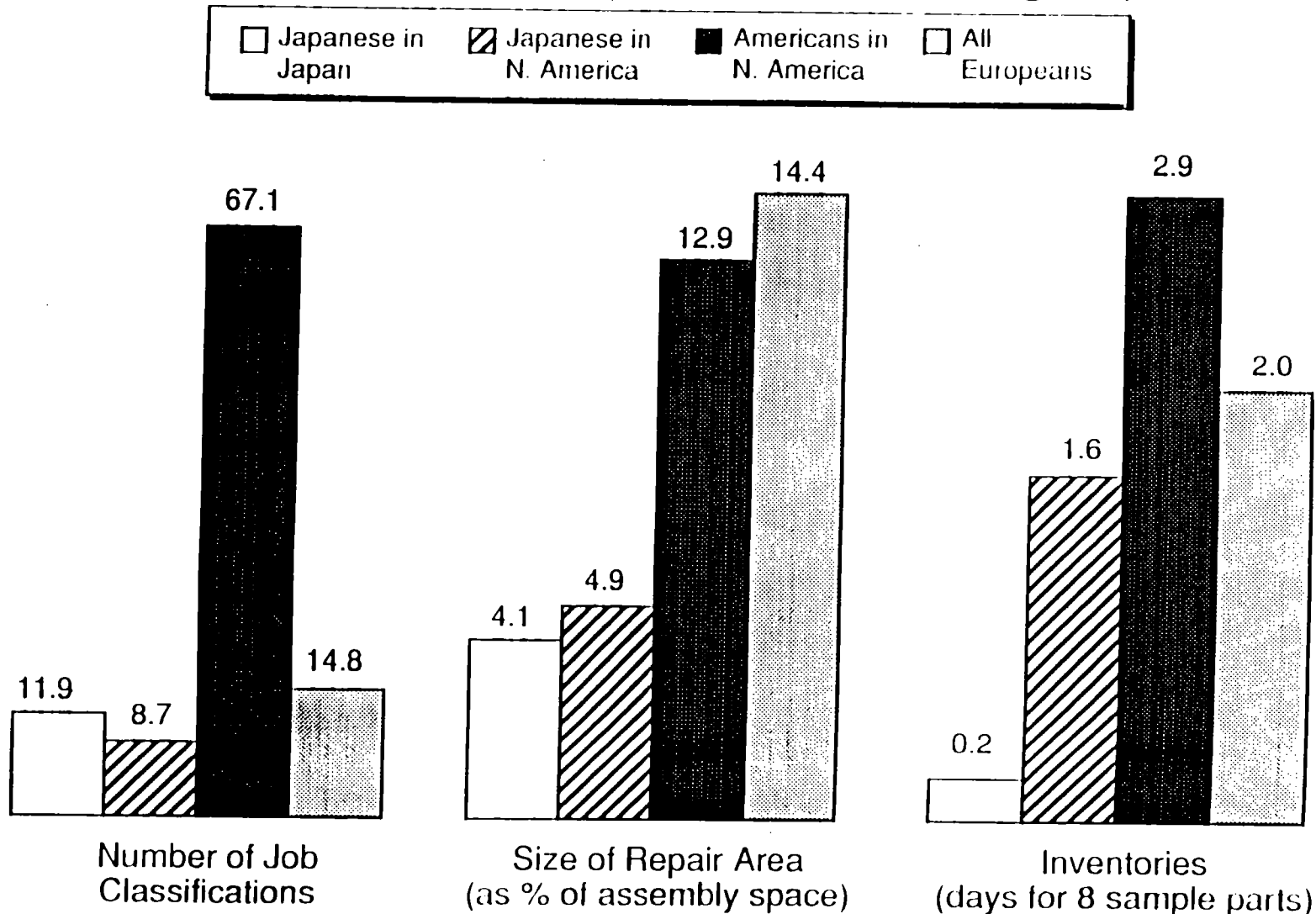
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Source: IMVP World Assembly Plant Survey, *The Machine That Changed the World*

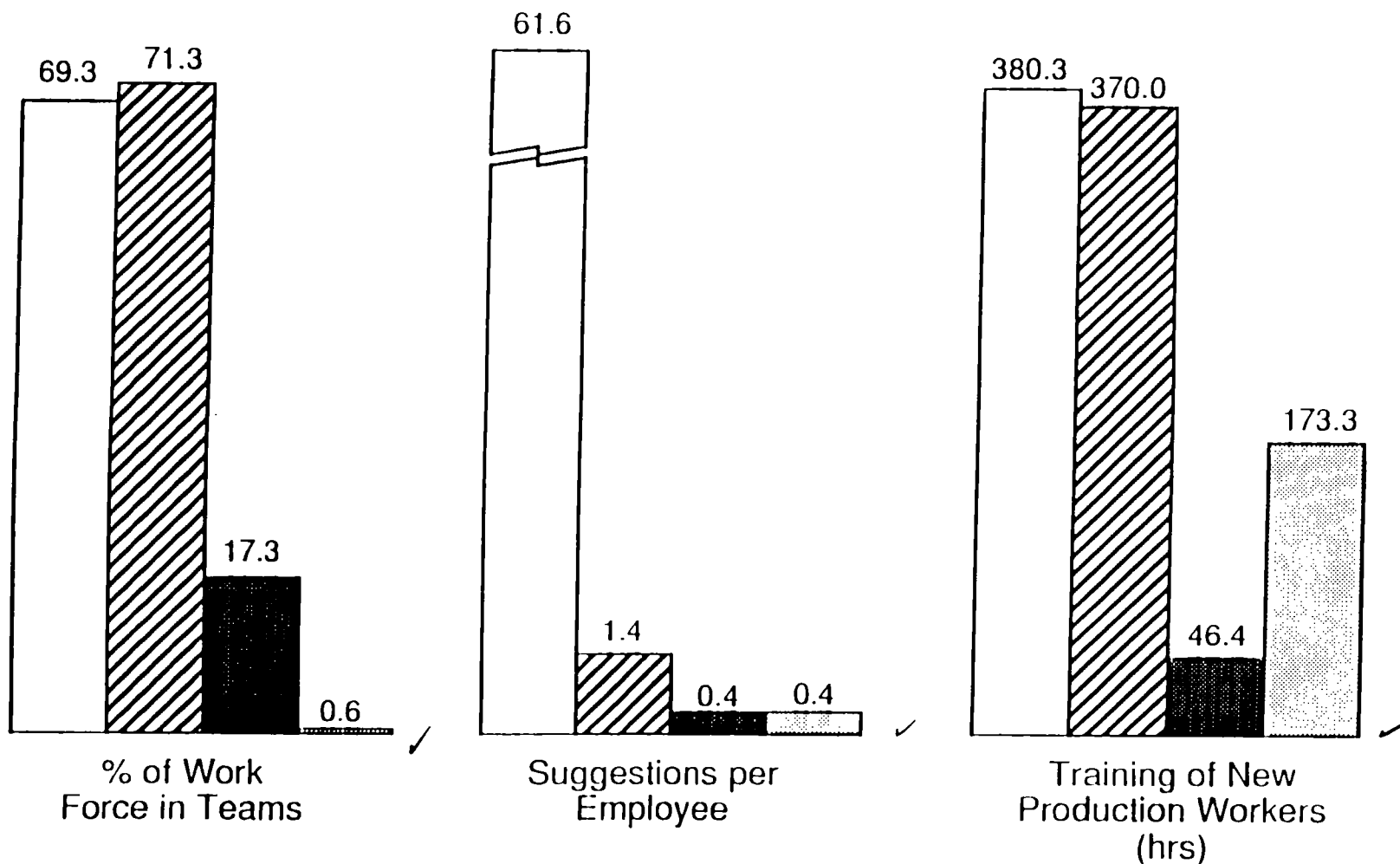
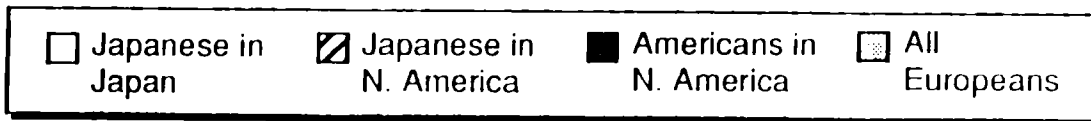
Summary of Assembly Plant Characteristics, 1989

(Averages for Plants in Each Region)



Summary of Assembly Plant Characteristics, 1989

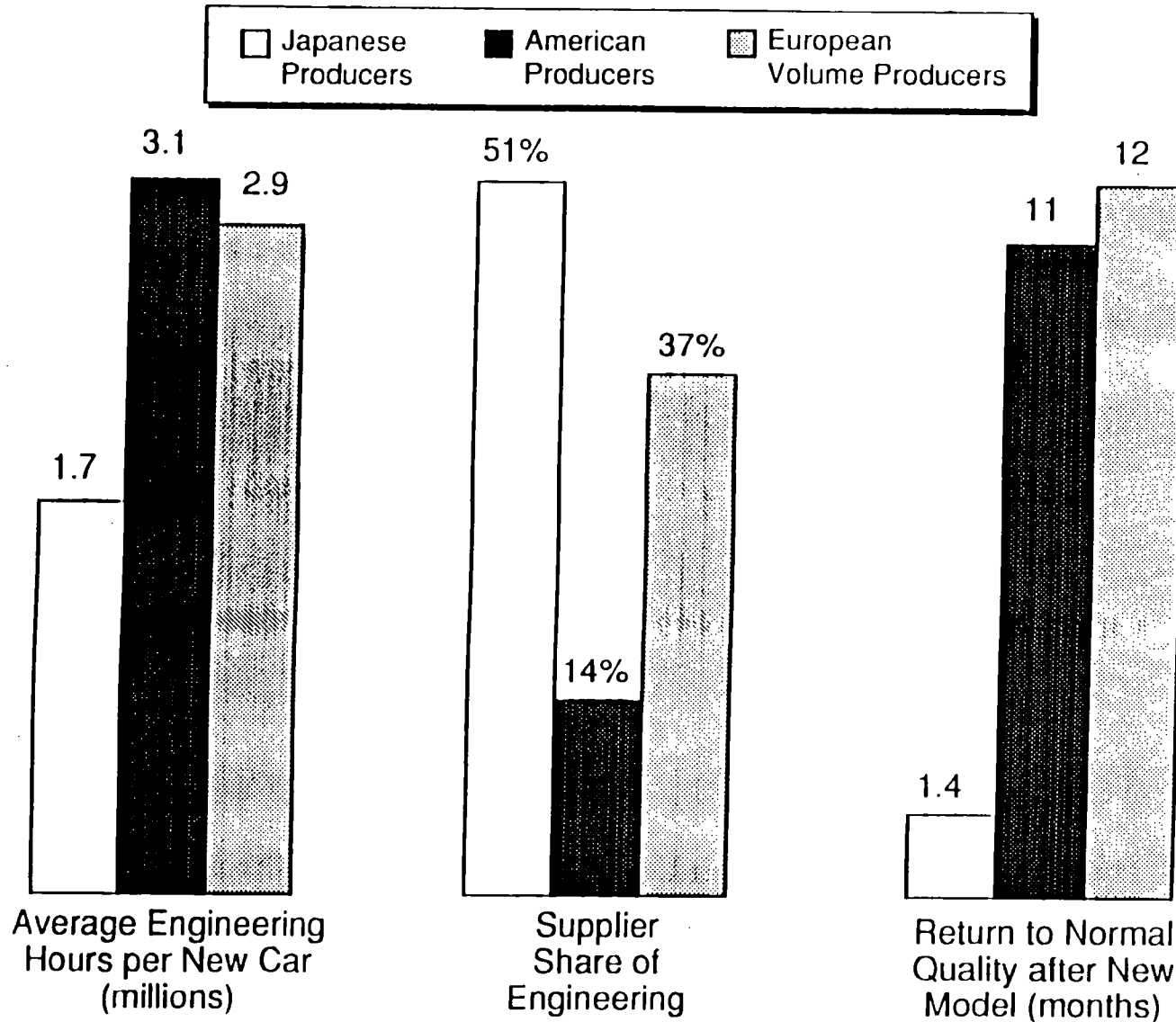
(Averages for Plants in Each Region)



Assembly Plant Study Lessons

- **High quality and productivity occur together in lean production — no tradeoff**
- **High performance plants can be found anywhere in world**
- **Design for assembly important advantage for world class assembly plant, but not primary factor**
- **Management and organizational principles primary factors influencing performance**
- **Payoffs of automation in lean production plant far greater than in mass production plant**

Product Development Performance by Regional Auto Companies



**FRAGMENTATION OF THE AMERICAN AUTO, VAN
AND
LIGHT TRUCK MARKET**

1955-1989

	1955	1973	1986	1989(2)
Total:				
Products on Sale (1)	30	84	177	142
Sales/Product (000s)	259	169	136	112
Share of Market Captured by 6 Largest-selling Products	73	43	25	24

Supplier Performance

Assembler—Supplier Relations

Number of Suppliers
Purchasing Staff

GM
2500
4000

Toyota
340
185

Pricing Practices

Target Price Ratio (%)
Annual Rate of Change in Prices (%)

US
109.4
0.9

Japan
97.6
-2.1

Defects

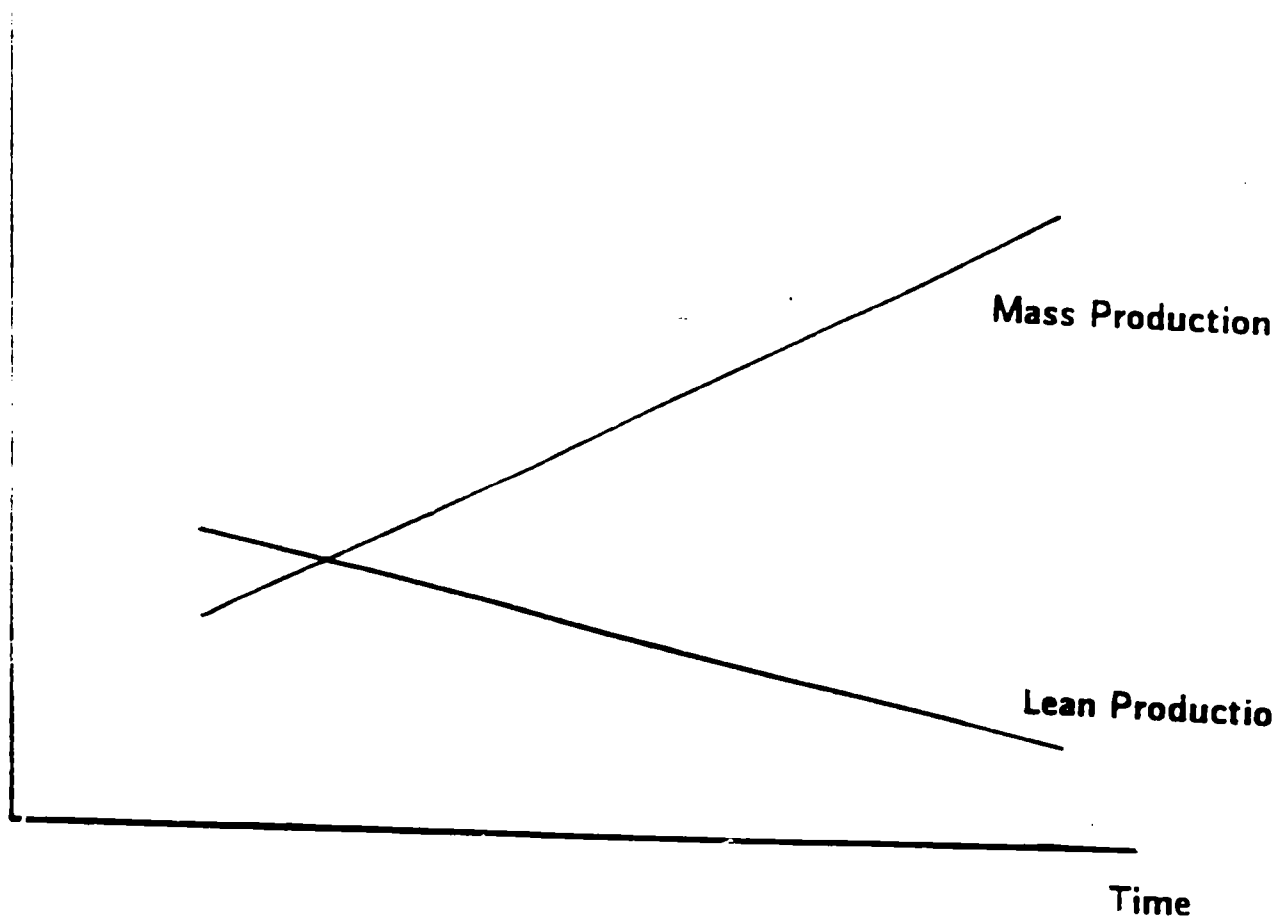
Defect Rate (%)
Annual Rate of Change in Defect Rate (%)

1.81
-1.7

0.01
-9.5

SUPPLIER RELATIONS

Component
Cost



Mass

Lean

Low bid selection

Negotiated selection

Change orders and
cost escalation

Continuous improvement
and price reduction

SUPPLIER PERFORMANCE

	JAPAN	U.S.	EUROPE
Die Change Time (Minutes)	7.9	114	124
Machines per Worker	7.4	2.5	2.7
Number of Daily JIT Deliveries	7.9	1.6	0.7
Number of Suppliers per Assembly Plant	170	509	442
Portion of Parts Delivered JIT (%)	45	14.8	7.9

LEAN PRODUCTION

Perfect First Time Quality

- Reveal and solve problems**
- Stop production line to fix problems**
- Educated knowledgeable work force**
- Group/team approach**

Waste Minimization (Equipment, Space, People)

- Remove all non-value added**
- Just-in-time inventory**
- Small final repair area**
- Empower Workers - Pass responsibility down value chain**
- Fewer supervisory and overhead personnel**

Continuous Improvement

- The quest for zero defects - Good enough is not good enough**
- Stress system and workers - no safety net**
- Dynamic changing process**

CHARACTERISTICS OF LEAN PRODUCTION SYSTEM

Quality - Find, correct and eliminate problems

Flexibility - small lot production, continuous flow

Time to Market - minimize development time

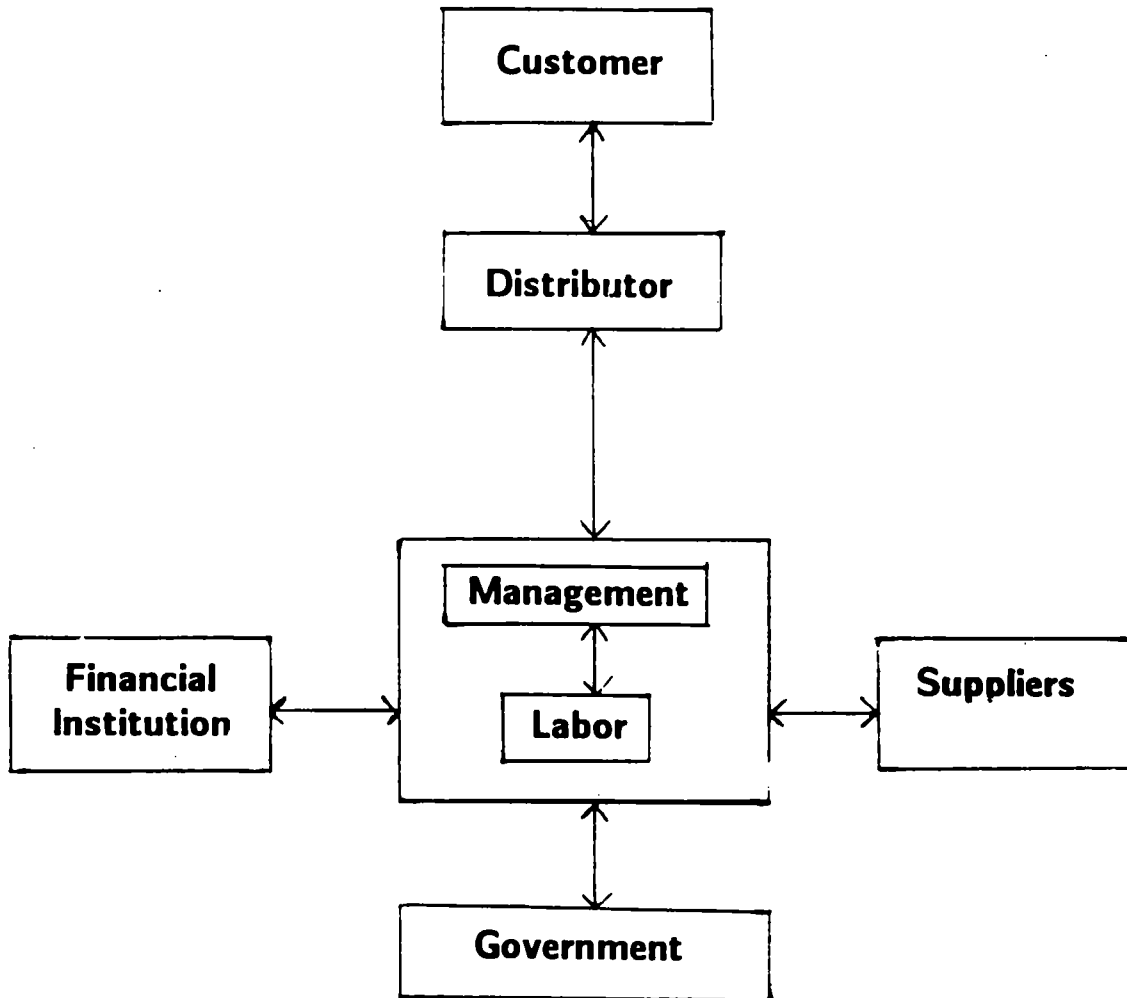
**Product Diversity - rapid product cycle, minimum scale
efficiencies**

Efficiency - productivity improvements, waste minimization

Adaptability - modular, coordinated, decentralized system

Learning - continuous improvement

CRITICAL LINKAGES



Lessons for Industry

- **Western auto companies misunderstood reason for Japanese advantage**
- **Western auto companies unwilling/unable to appraise own problems**
- **Lean companies operate with different systematic principles**
- **Lean companies have different corporate culture, organizational structure, operational framework**
- **Mass to lean transition requires fundamental change — process difficult, takes time, but possible**

NUMMI

GM plant in Fremont, CA
Worst productivity and quality
Poor labor relations
Plant closed in 1982

Joint venture GM/Toyota plant
Reopened in 1984
Same assembly lines
Same workers (80% rehired UAW workers)

CHANGES - GM/FREMONT VS NUMMI

Toyota management-

Implemented lean manufacturing philosophy

Work organization

Few job classifications

Worker teams

Focus on quality

Immediate assembly line shutdown by workers

Just-in-time inventory - 2 days vs 2 weeks

**Design for manufacturability - Toyota Corolla
(Nova, Geo Prizm)**

NUMMI RESULTS

	<u>GM Fremont</u>	<u>NUMMI</u>
Assembly hours/car	36.0	19.0
Assembly defect/car	1.5	.5

Worker absenteeism - reduced from 15% to 1.5%

Repair area - reduced from 15% to 7%

THE TRANSITION FROM MASS TO LEAN PRODUCTION

Assessment and awareness of the need to change

Commitment to change

Change strategy

ORGANIZATIONAL CHANGES

Top management commitment

Cultural change

Structural change not downsizing

Different job responsibilities

Factory workers

Union officials

Engineers

Holistic organization

Design - production

Financial control - operations

Assembler - supplier

PROVIDE INCENTIVES, REWARDS AND EDUCATION

Compensation system to reward group contributors

Information systems to support decision making

Accounting systems to reflect operations

Information systems for empowered workers

Education and training to prepare for new and broadened career paths

Supplier evaluation criteria to reinforce long-term relationships

STEPS TO DIFFUSE LEAN PRODUCTION

Creative crisis to initiate change

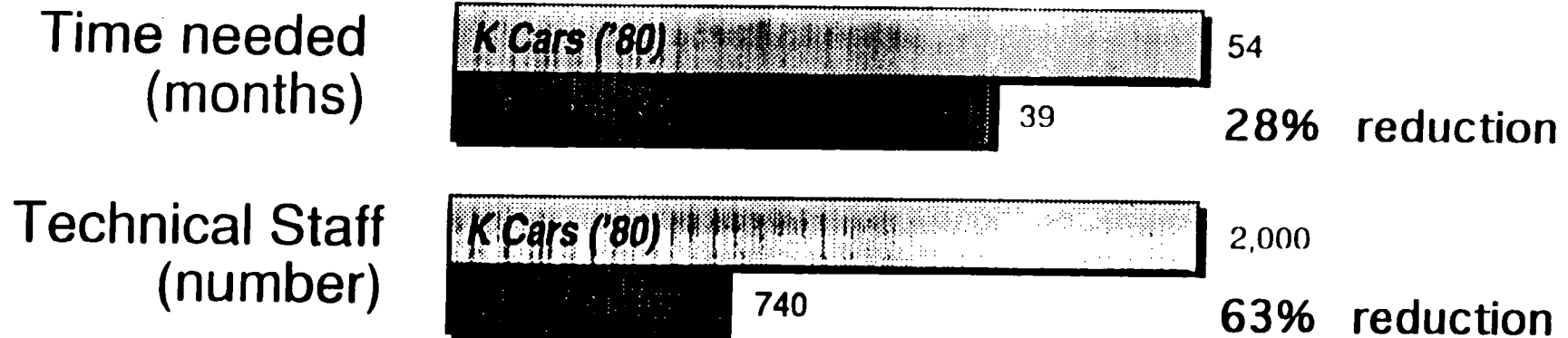
Functional equivalent to learn - NUMMI

Strategy of diffusion

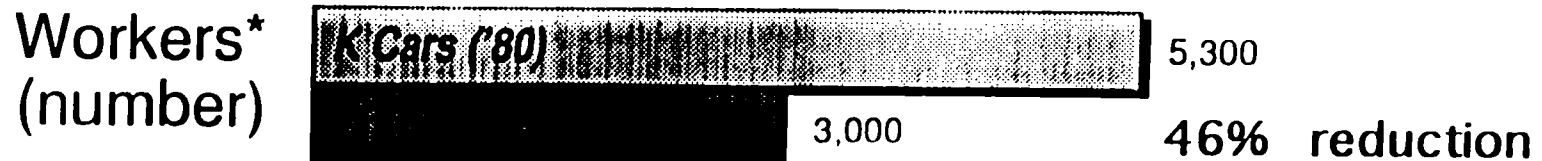
Adapt don't imitate

Chrysler Then & Now

Product Development



Production



* Required to operate one plant with two shifts

SOURCE: Chrysler Corp.

THE AUTO AT THE NEXUS OF MAJOR INTERNATIONAL CONCERNS

Competitiveness

Mobility

Energy

Safety

DEPENDENCE ON AUTOS FOR MOBILITY WILL CONTINUE

People Like Cars

Social Benefits

**No Reasonable Alternatives - Transit Plays Important
But Limited Role**

Adaptable Technology

Investment in Road Infrastructure

Auto Diversion Measures of Limited Effectiveness

DOMESTIC AUTO OWNERSHIP GROWTH IS OVER IN THE U. S.

End of Baby Boom

Female Auto Ownership Leveling

Ownership Approaching Saturation (.95 vehicles/person of
driving age)

Average Age of Cars Increasing

1970	5.6 years
1980	6.6.years
1990	7.8 years

JAPAN AUTO COMPANY PROBLEMS

Domestic Market Downturn

Reduced Profits and Losses

Exchange Rates

Cost of Capital

Export Limitations

Social Concerns - Just-in-time

Labor Availability and Dissatisfaction

The Limits of Continuous Improvement

JAPANESE AUTO COMPANY RESPONSES

Shift Focus From Market Share To Profitability

Lengthen Product Replacement Cycle

Reduce Product Variety

Exert Pressure On Suppliers

Cost Cutting

Pull Back Development Operations To Japan

Prepare For Social Concerns/Energy Efficiency

Continued Aggressive Behavior

U. S. AUTO INDUSTRY - CURRENT

Quality/Productivity Gap Has Closed But Still Exists

Two Industries - Big Three and Transplants

Japan Market Share Decrease

Profitability Reemerging

Increasing Light Truck Market - High Profits/Minimal
Competition

Implementing The Lean Enterprise - Good Start But Much To
Accomplish

Can U. S. Build A Profitable Small Car - The Neon Potential

U. S. AUTO INDUSTRY - FUTURE

GM and Chrysler Very Fragile

GM market share will decrease

Chrysler needs capital, R&D, and international presence

**Big Three Will Survive But Lose U. S. Market Share to
Transplants**

Fewer But Stronger Competitors in Europe and Japan

Several firms will disappear

U. S. Parts Industry Will Undergo Profound Changes

U. S. TRANSPLANTS

Japanese Growth Will Occur Through Transplants

Local Content of Transplant Cars Is Increasing

European Transplants in U. S.

American/Japanese Exports to Europe

NAFTA Important

STATE SUBSIDIES TO ATTRACT TRANSPLANTS

<u>Transplant</u>	<u>Year</u>	<u>State Subsidy Employed Person</u>
Honda	1982	\$ 2,500
Nissan	1983	\$ 6,470
Mazda	1987	\$14,263
Diamond-Star	1988	\$28,724
Toyota	1988	\$42,771
Subaru-Isuzu	1989	\$98,059

SUPPLIERS

Global Sourcing

Structural Reorganization in U. S. - Tiering

Big Three Shed Supplier Divisions

New Entrants - Materials And Electronics

Japanese Transplants Will Increase Local Content

Lopez - How To Build Trust Relationships

Long Term Joint Development With Assembler

Delay In Lean Implementation

U. S. Needs Group Structures

LABOR

Fewer Jobs - Downsizing and Automation

Two Cultures

The Need for Change

Cooperation vs. Confrontation

The Importance of Human Resource Issues

THE SOCIAL AGENDA

An International Product Subject To Conflicting Regional and
National Regulations

Two Emerging Concerns

Recycling - Extended Producer Responsibility
Global Warming

Cooperating To Compete

The Need For A Shared Vision
Getting Ahead Of The Curve

Life Cycle Analysis

A Systematic Framework for Public Policy and
Corporate Planning

ENVIRONMENTAL CONCERNS AFFECT ALL ASPECTS OF COMPANY

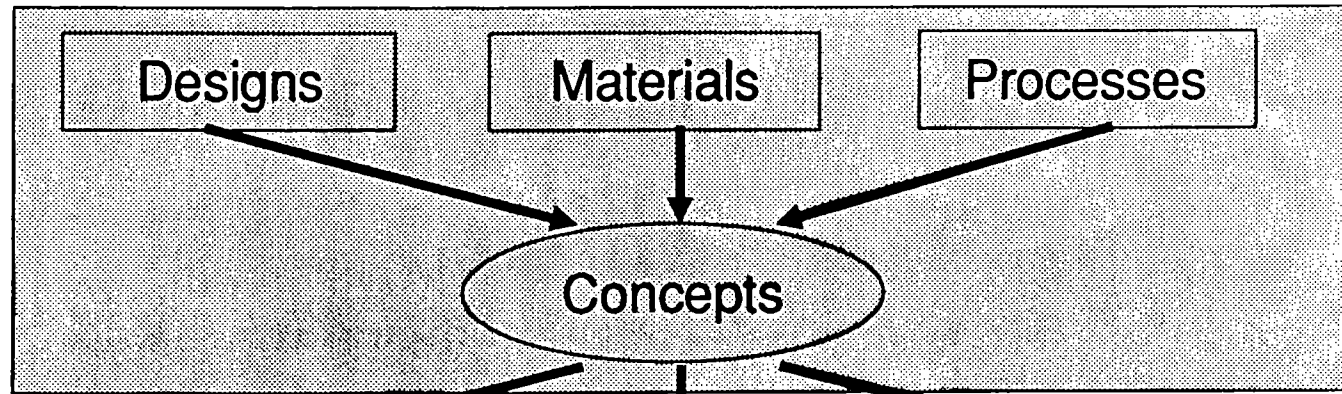
Its Products

Its Design and Manufacturing Processes

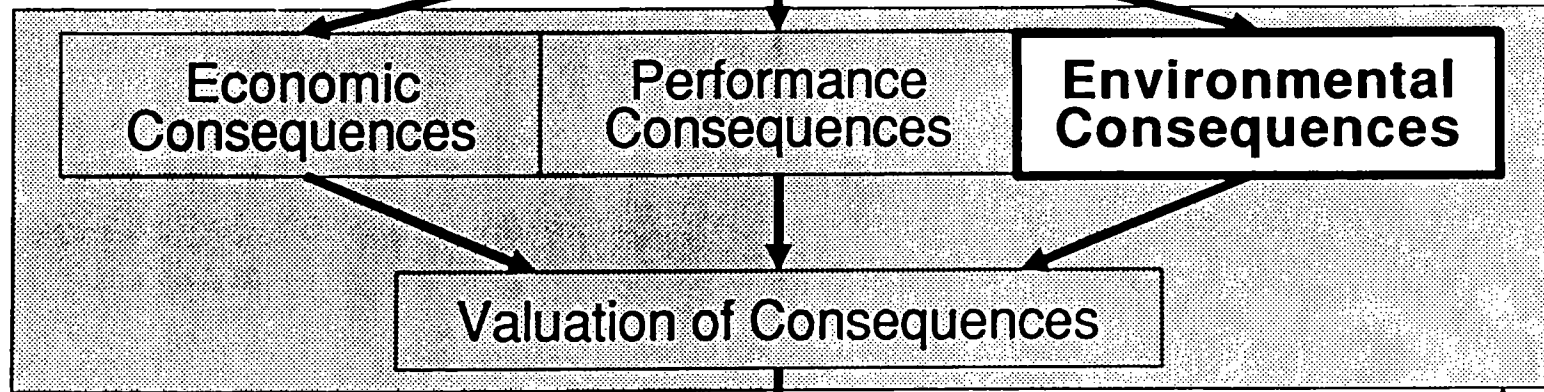
Its Organization

Its Strategic Planning Process

Concept Development



Analysis



Implementation

Design/Material/Process Choice

Implementation of Choice

Evaluation & Learning

Evaluation of Results

Revision of Analytical Processes



INDUSTRY CHALLENGES

Understanding Social Responsibility

Cooperating to Compete

New Roles and Relationships with Government

**A Shift from Reactive Regulatory Approach to
Proactive Initiative Approach**

COLLIDING SOCIAL OBJECTIVES

CAFE - Avoid Unrealistic Requirements - Follow advice of NAE Report and hope for realistic energy tax.

Global Warming - Rio agreement has major implications on auto industry.

Clean Air - Slow down California regulations which are technology push. Discourage adoption by other states.

Electric Cars - Battery technology and cost are major factors. Continue in R&D and demonstration mode.

THE PRESENT REGULATORY SYSTEM DOESN'T WORK WELL

Confusion, Contradiction and Gridlock

Regulations Don't Reflect Scientific and Technological Realities

Regulations Focus on Specific Issues and Don't Reflect Systematic Perspective of all Social Concerns

Regulations Don't Reflect the Realities of the Production Process

IMPROVE SOCIAL OBJECTIVES THROUGH A BALANCED STRATEGY

Auto Production/Auto Use

Improve Technology/New Technology

IMPORTANCE OF AUTO USAGE STRATEGIES

Greater Impact

200 million existing vehicles
10 million new vehicles

Bigger Problems

Older vehicles less efficient than newer vehicles

Broad Range of Strategies

BROAD RANGE OF AUTO USAGE STRATEGIES

**Improvement - Target Problem Vehicles Through Inspection
and Manitenance**

Replacement - Retire Older Inefficient Vehicle Fleet

Improve Efficiency

Ride Sharing

Transportation System Management

Road Pricing

IVHS As Framework

INTELLIGENT VEHICLE AND HIGHWAY SYSTEMS

An information infrastructure combined with the physical infrastructure to provide a new framework for the provision of transportation services.

- better manage traffic
- control or restrict traffic
- increase traffic flow

U.S. FACES FUNDAMENTAL BREAKDOWNS

Labor/Management

Assembler/Supplier

Industry/Government

POSSIBLE GOVERNMENT INITIATIVES

Better Information - Knowledge Base

**Better Coordination Within Government - National
Framework**

Better Communication With Industry - Shared Vision

Proactive Cooperation - Clean Car

**Reconnect The Disconnects - Labor/Management
Assembler/Supplier**

Rationalized National Social Agenda

Harmonized International Regulations

NAFTA

Health Care

Worker Retraining

Trade Monitoring and Dialogue - Auto Parts, Europe

IMVP ENTERS A NEW PHASE

Sponsorship By Worldwide Industry

Government Sponsorship Critical

Sloan Foundation Industry Programs - Centers of Excellence

Critical Issues

Expand The Knowledge Base - Best Practice

Corporate Product Development

Distribution

The Transition To Lean Production

Industrial Performance

The Sustainable Corporation

Stakeholders and Changing Relationships

The Social Agenda

Getting Ahead Of The Curve

BEYOND LEAN PRODUCTION

Is Green Compatible With Green?

Lean Is Changing

Other Paradigms - Agile

GETTING AHEAD OF THE CURVE

Cooperating to Compete

MIT as Facilitator

Understanding Social Choices and Trade-offs

Bring All Parties Together To:

Understand Source of Disagreements

Develop Consistent Approaches

Harmonization of Regulators

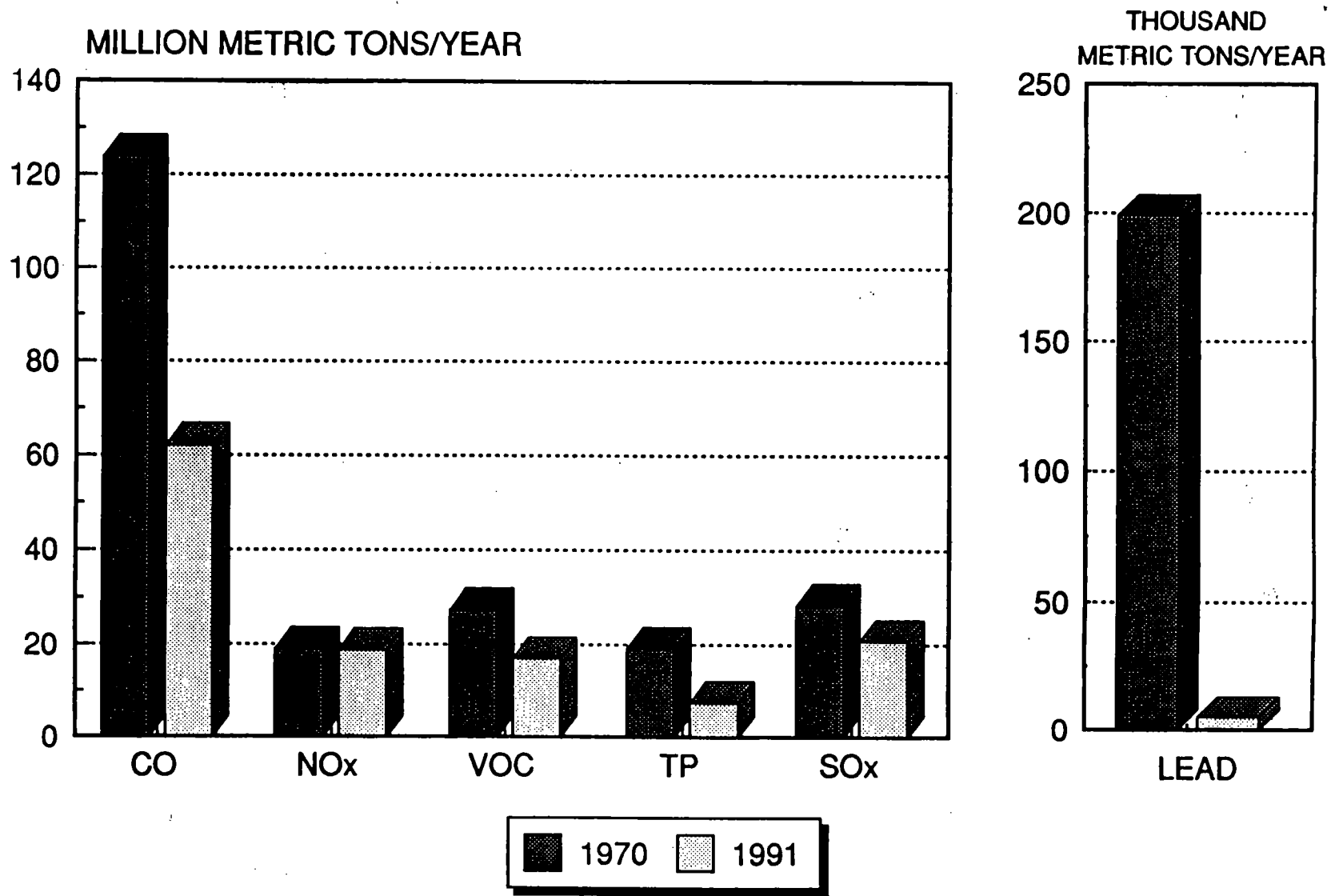
EPA
AND THE
AUTO INDUSTRY

Presentation to
NEC Workgroup
May 11, 1993

AGENDA

1. Programs affecting vehicles
 - A. Air pollution
 - B. Greenhouse gases
2. Programs affecting factories, facilities & operations
3. Development of low emission technologies

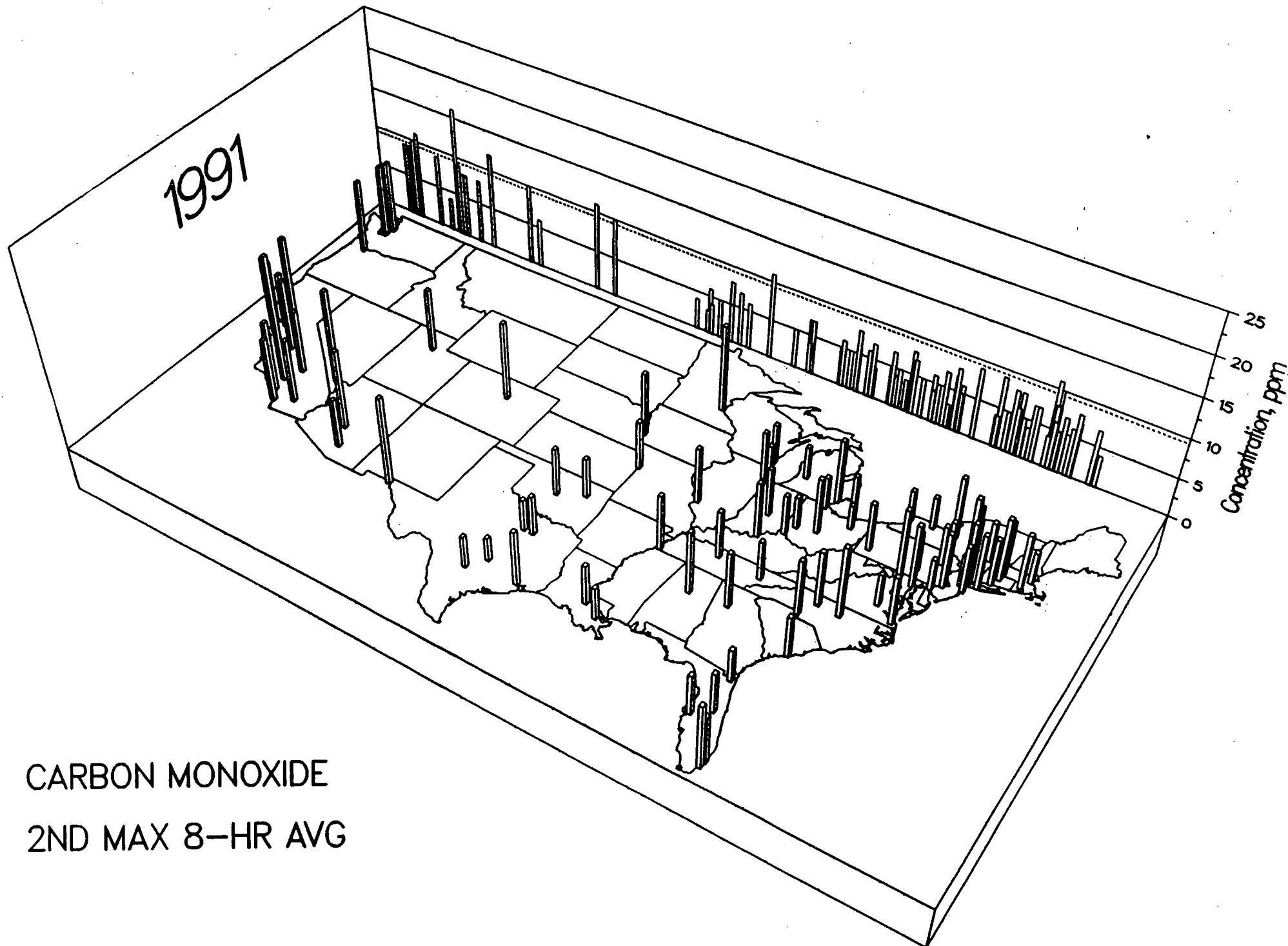
Comparison of 1970 and 1991 Emissions



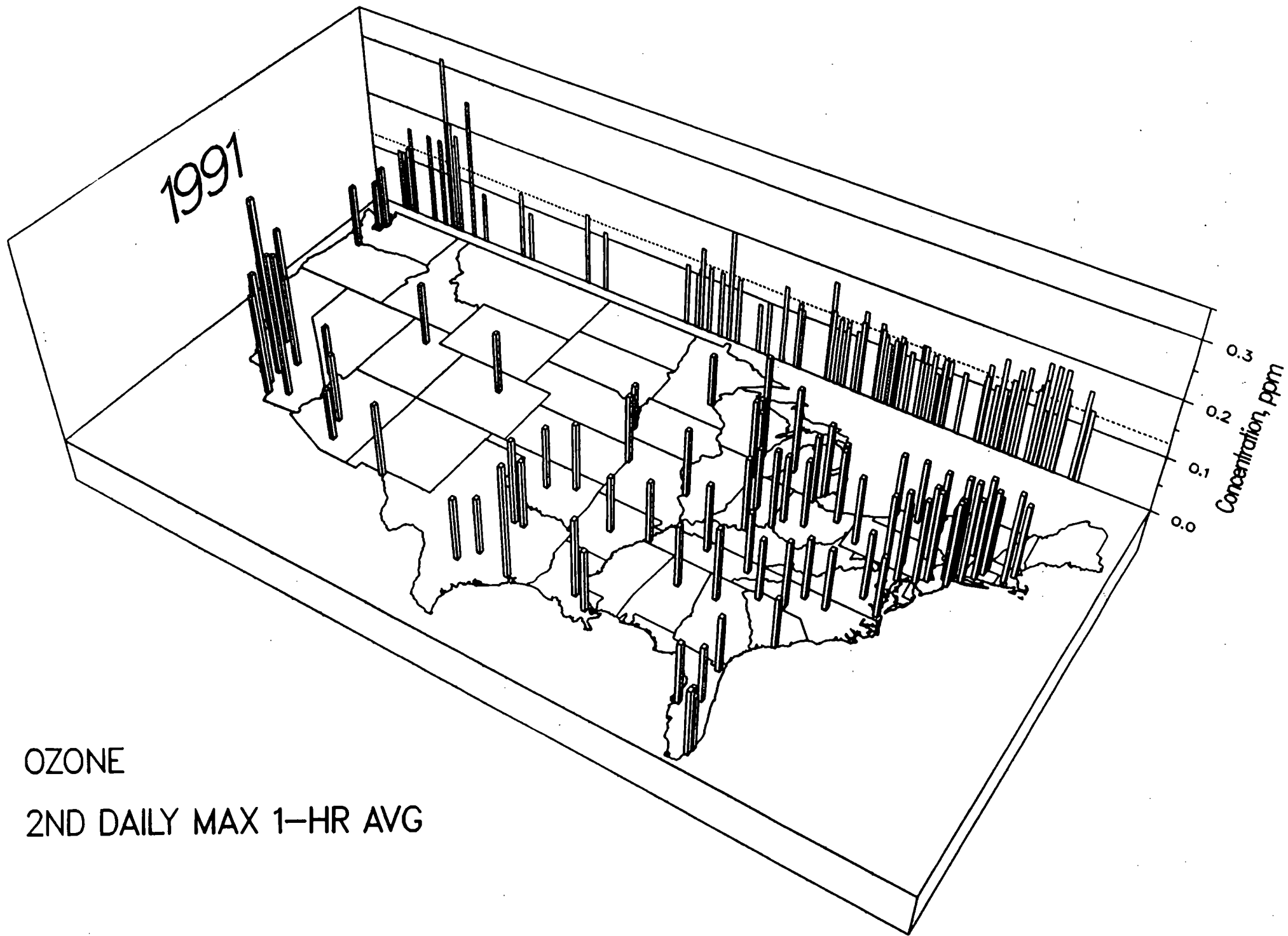
Ten Year Air Quality and Emissions Trends 1982 - 1991

Pollutant	Air Quality Percent Change	Emissions Percent Change
Carbon Monoxide	- 30%	- 31%
Lead	- 89%	- 90%
Nitrogen Dioxide	- 6%	- 8%
Ozone	- 8%	- 13% (VOC)
PM-10 *	- 10%	- 5%
Sulfur Dioxide	- 20%	- 2%

* PM-10 percentages are based on 1988-91 data.



1991

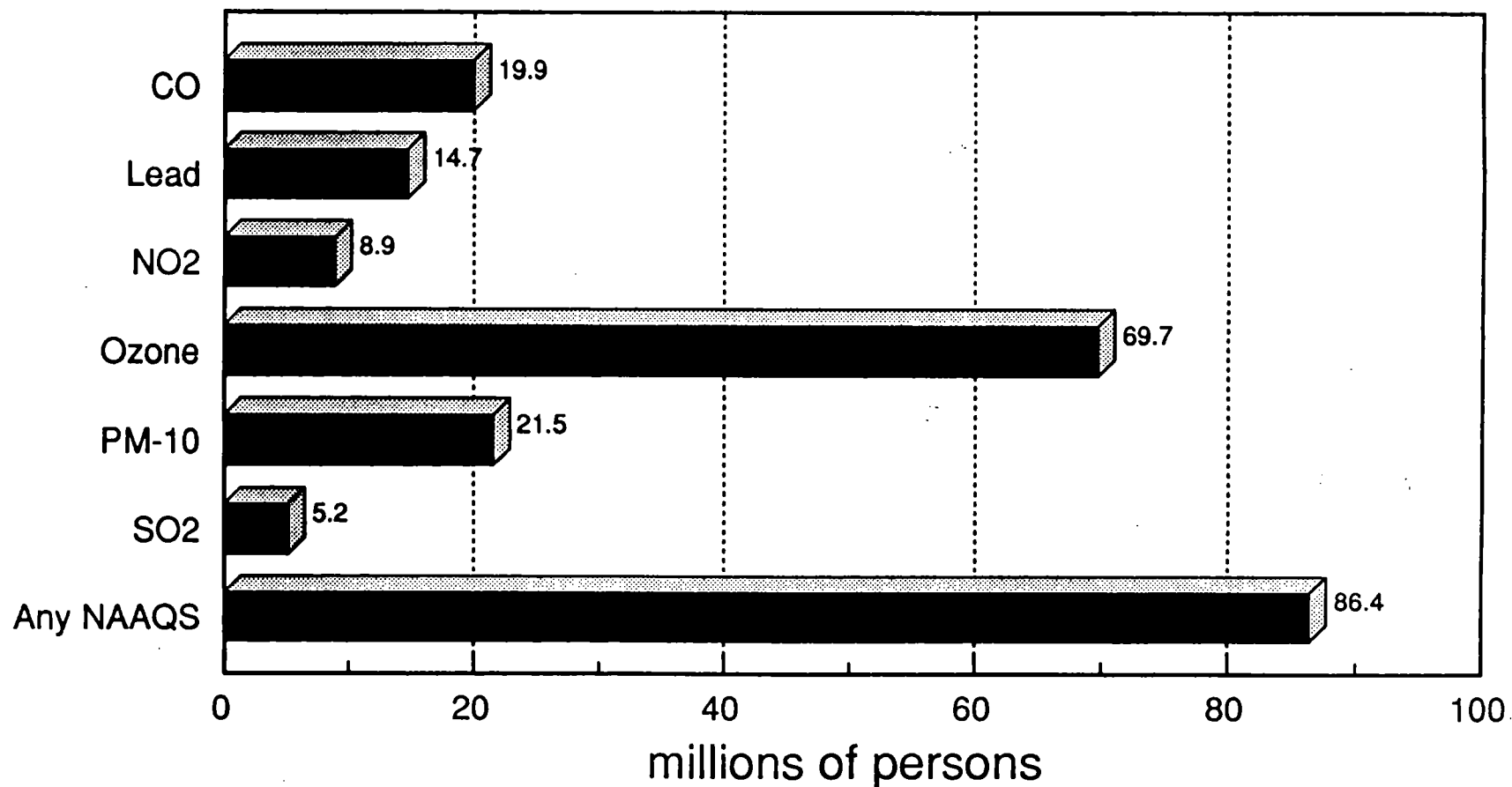


OZONE

2ND DAILY MAX 1-HR AVG

Number of Persons Living in Counties with Air Quality Levels Above the primary National Ambient Air Quality Standards in 1991

pollutant



Based on 1990 population data.

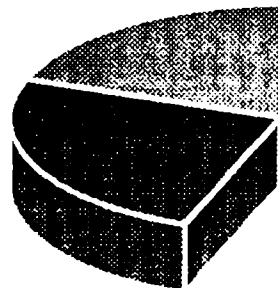


The Contri- bution of Motor Vehicles

Pollutants:



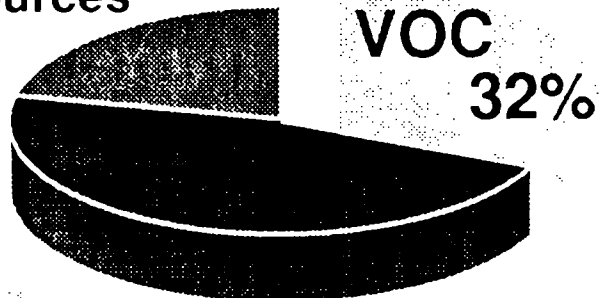
CO
72%



Toxics
56%

Carbon
Dioxide
(CO₂):

Area Sources



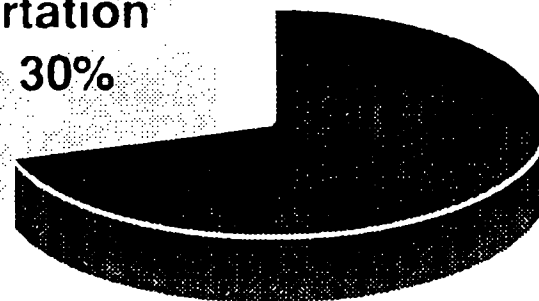
VOC
32%

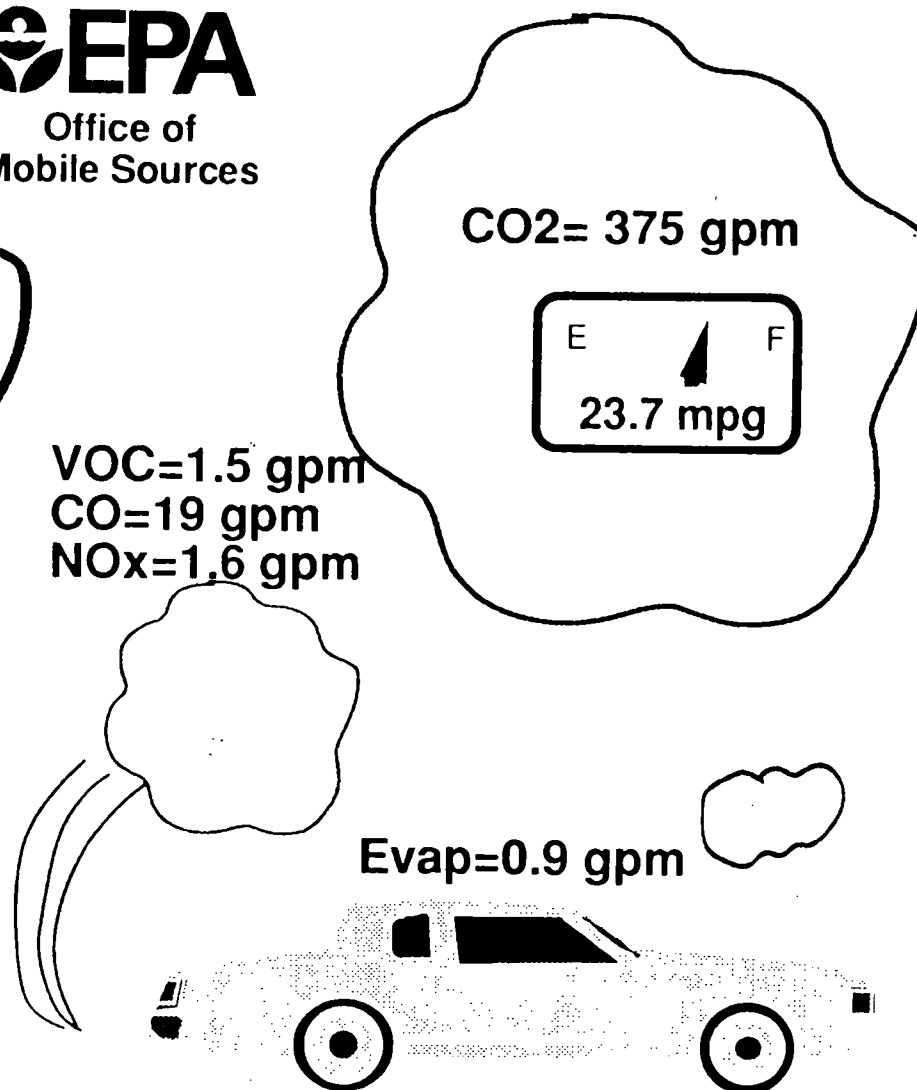
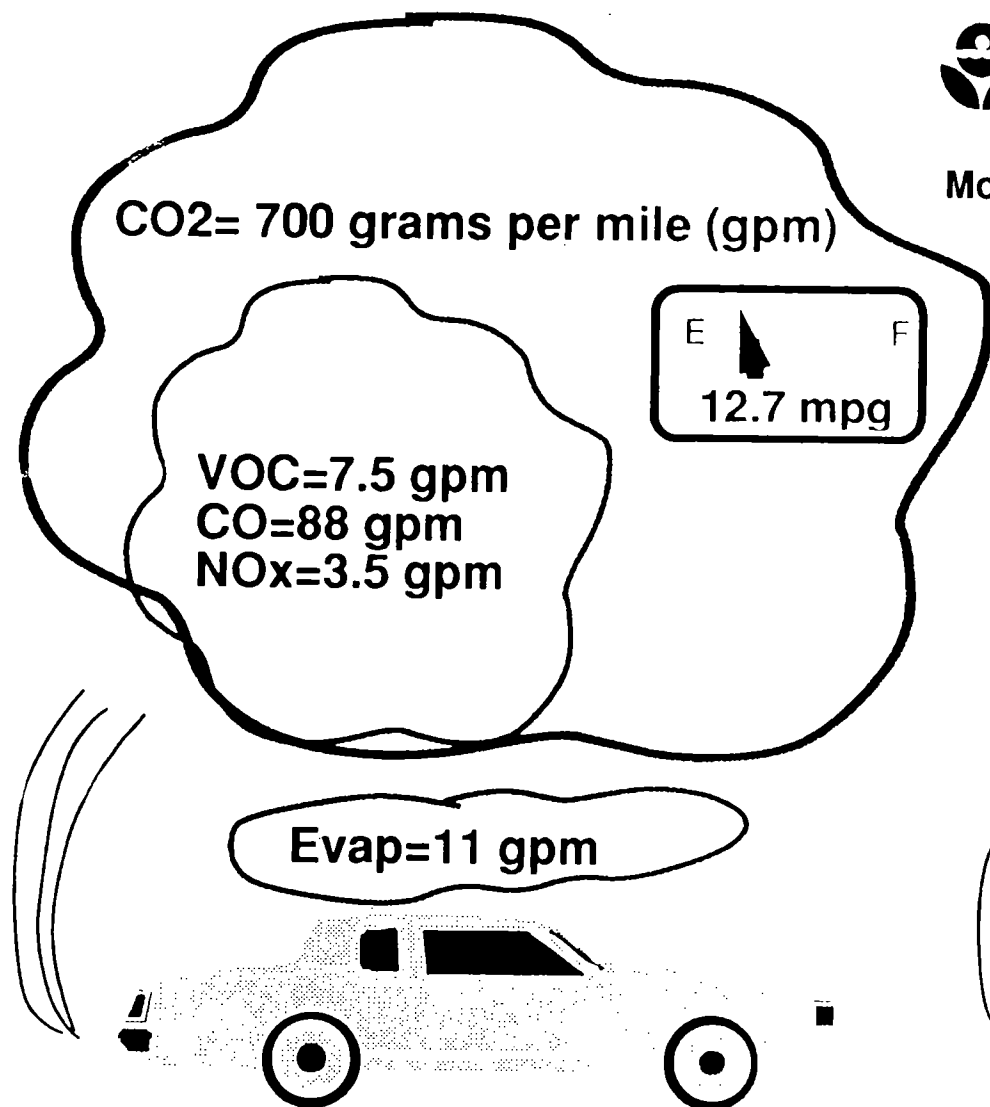


NOx
40%

Point Sources

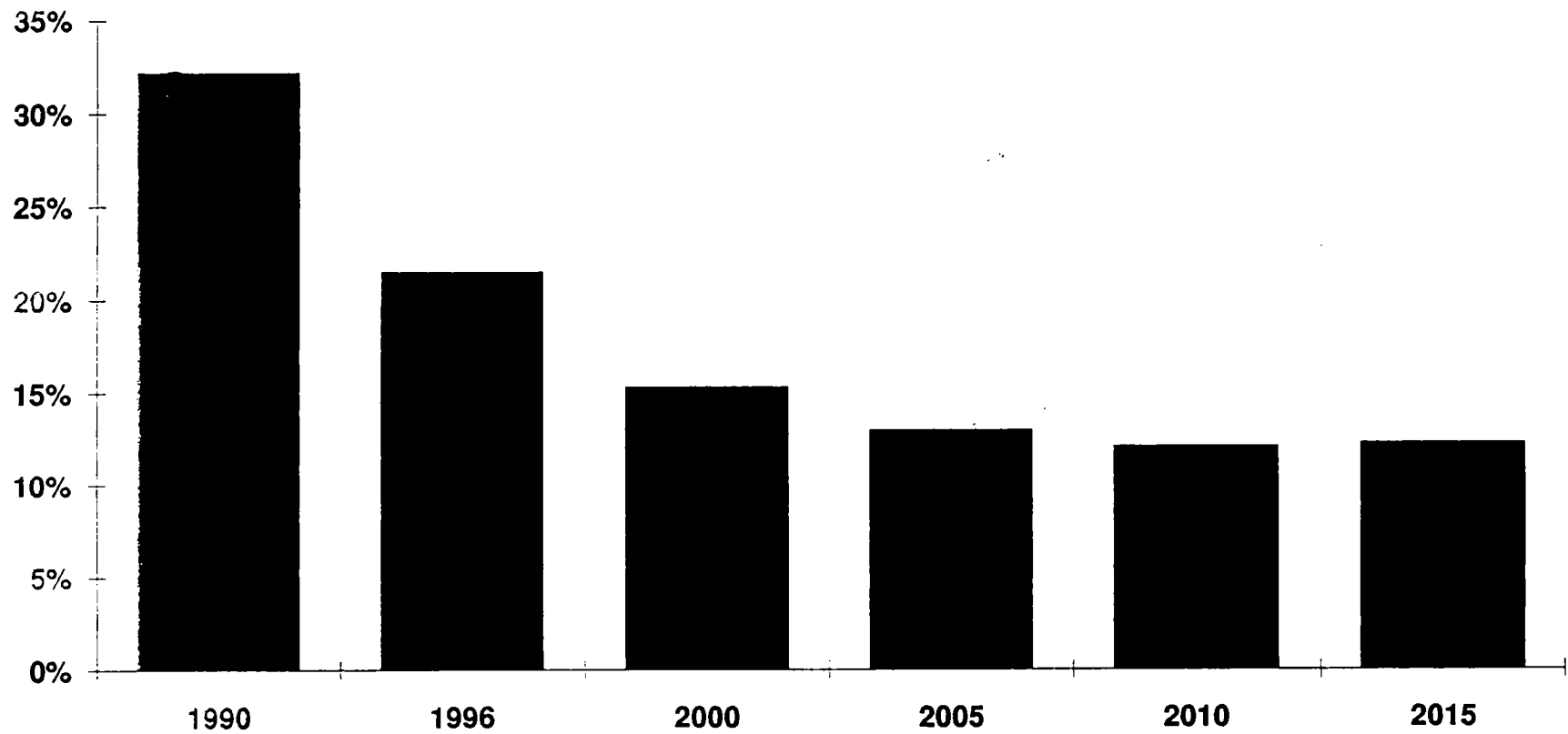
Transportation
30%



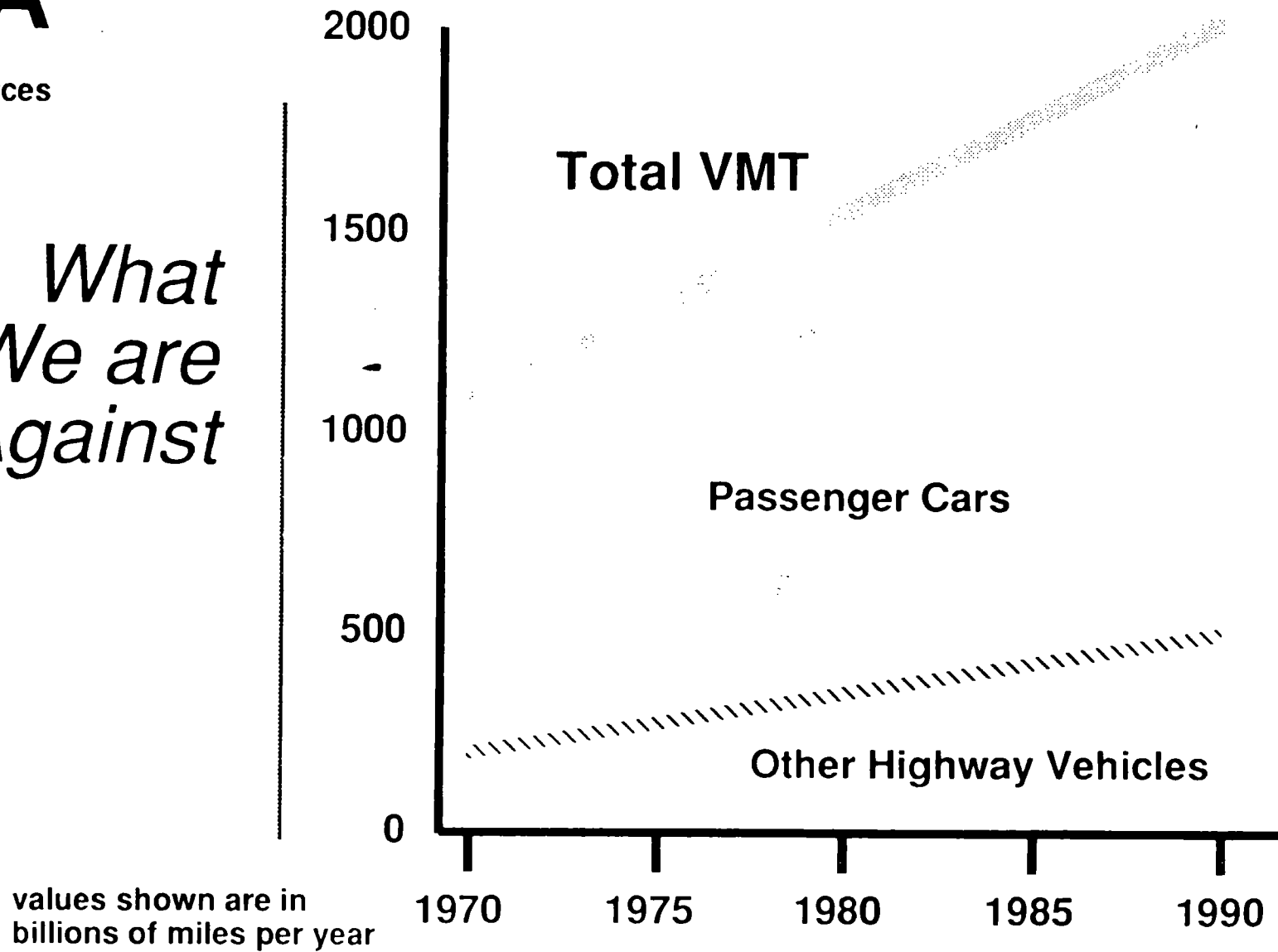


A typical 1970 car versus a typical 1990 car

HIGHWAY VEHICLE FRACTION OF TOTAL INVENTORY



*What
We are
Up Against*



BASIC PROGRAMS AFFECTING MOTOR VEHICLES

- **Statutory Authority: Clean Air Act**
- **Standard setting - performance-based, national requirements**
 - Tailpipe standards (HC, CO, NOx, particulates)
 - Evaporative standards
 - Covers passenger cars, light trucks, heavy trucks, buses and motorcycles
- **Enforcement**
 - Pre-production certification
 - Assembly line testing
 - In-use (recall); now 5 years/50,000 miles for cars increasing to 10 years/100,000 miles in 1995
 - Warranty and anti-tampering
- **Emission testing and modeling**
- **Coordination with NHTSA on regulations and policies affecting emissions and safety.**

OTHER AIR POLLUTION CONTROL PROGRAMS

- Cleaner fuels
 - Low volatility gasoline
 - Oxygenated fuels
 - Reformulated gas
 - Low sulfur diesel fuel
- Clean fleet program
- Beginning to address nonroad engines
- Transportation-related programs
 - Conformity
 - Employee commute options
 - Transportation control measures

EPA establishes performance standards for state-run Inspection/Maintenance programs

CAR AND LIGHT TRUCK PROGRAM STATUS

COMPLETED

- Tier 1 in 1994:

30% VOC ↓

60% NOx ↓

- Cold CO

- New Enhanced I/M in 83 cities:

28% VOC ↓

31% CO ↓

9% NOx ↓

- Improved Evaporative Controls
- Onboard Diagnostics
- California LEV Waiver
- Emissions Credits Trading

example: "Cash for Clunkers"

CAR AND LIGHT TRUCK PROGRAM STATUS

IN PROCESS

- Fleets
- Tier 2
- Onboard Refueling
- Vehicle Maintenance Initiative
- Promote/Develop Low Emission Technologies and Clean Fuels

CALIFORNIA'S LEV PROGRAM IS BASED ON PHASE-IN OF FOUR VEHICLE CATEGORIES

(All measurements grams per mile)

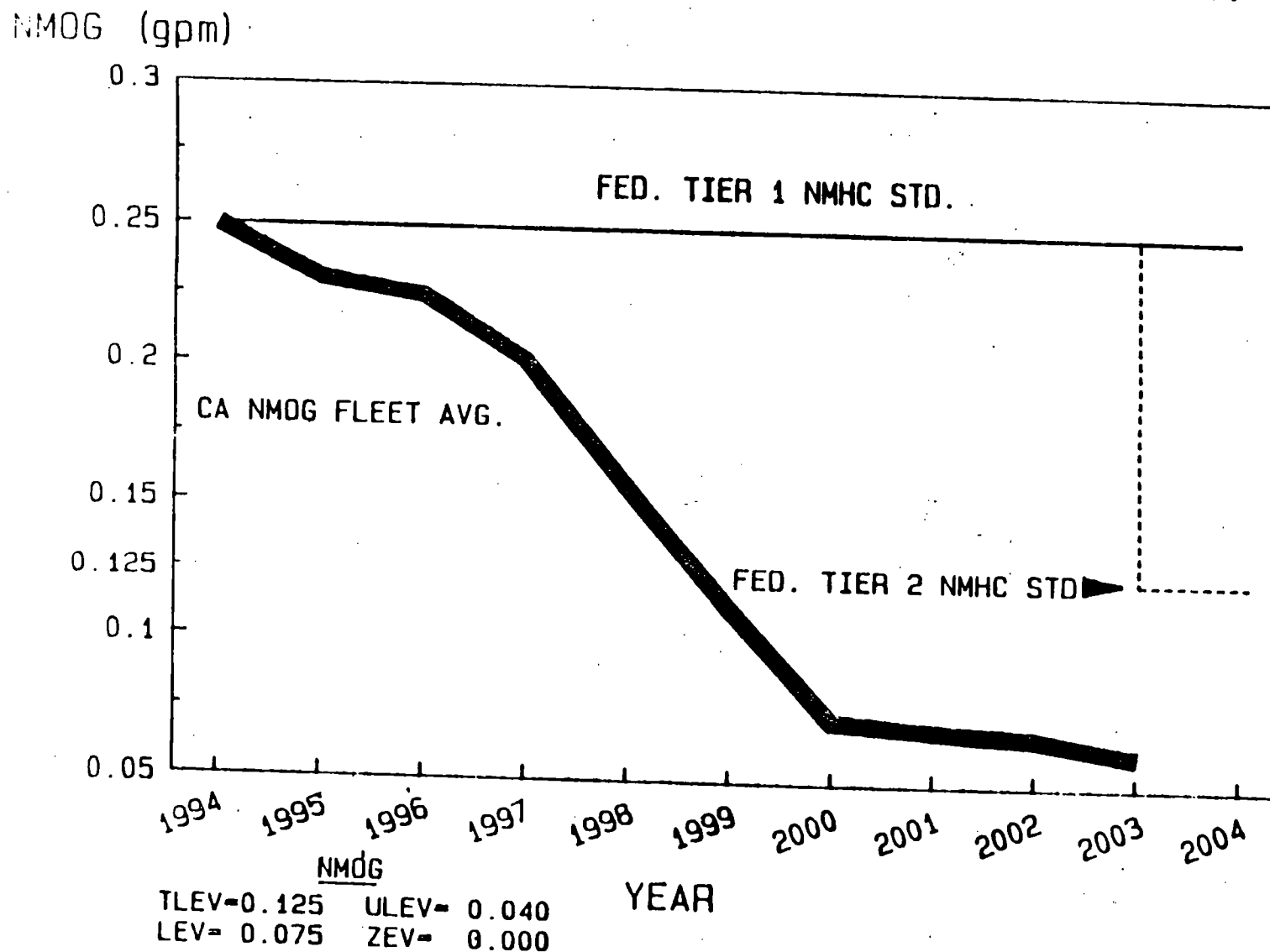
<u>Category</u>	<u>NMOG*(HC)</u>	<u>CO</u>	<u>NOx</u>
Transitional Low Emission Vehicle	0.125	3.4	0.4
Low Emission Vehicle	0.075	3.4	0.2
Ultra Low Emission Vehicle	0.040	1.7	0.2
Zero Emission Vehicle	0.0	0.0	0.0
(FED) Tier I	0.25**	3.4	0.4
Tier II	0.125**	1.7	0.2

* NMOG = NMHC + alcohols + carbonyls

** NMHC

Office of Mobile Sources
April 26, 1993

PHASE-IN IS GOVERNED BY INCREASING STRINGENCY OF NMOG FLEET AVERAGE REQUIREMENT



CALIFORNIA'S PROJECTED VEHICLES

<u>Category</u>	<u>Fuel</u>	<u>Emission Equipment</u>
TLEV	mostly gasoline few alternative/flex fuel	best of currently available technology
LEV	mostly gasoline some alternative/flex fuel	TLEV technology plus EHCs on larger vehicles
ULEV	mostly gasoline some alternative/flex fuel	LEV technology, EHCs on all vehicles, plus fuel system refinements
ULEV Hybrid	gasoline/alt fuel & electricity	battery powered, with gas auxiliary engine
ZEV	electricity	battery powered (fuel-fired heater allowed)

Office of Mobile Sources
April 26, 1993

ADOPTION HAS BEEN COMPLETED BY THREE STATES AND IS UNDER CONSIDERATION BY OTHERS

Final Regulations Published

New York
Massachusetts
Maine

Proposed Regulations Published

New Jersey

Legislation Passed in 1993

Maryland

Legislation and/or Regulations
Likely in 1993

Delaware
Pennsylvania
Vermont

Legislation and/or Regulations
Anticipated in 1994

New Hampshire
Rhode Island

Legislative and/or State Regulatory
Agency Consideration Underway

Connecticut
District of Columbia
Minnesota
Texas
Virginia
Washington
Wisconsin

NOTE: OTC States may also ask EPA to require LEV program in their states.

Office of Mobile Sources
April 26, 1993

MOBILE SOURCE REDUCTIONS BY MEASURE*

	Emission Factor (grams/ mile)	
Typical passenger car in 2020 without new CAAA controls, but with Basic I/M.	2.54	
	Emission Factor Reduction (grams/ mile)	% Reduction
High-Tech Enhanced I/M	-0.72	28%
Tier 1 Exhaust Standards	-0.15	6%
Phase I Reformulated Gasoline	-0.27	11%
LEV Program	-0.16	6%

*Based on the incremental effect of each measure on passenger car emission factors in 2020.

EPA'S ROLE IN MOTOR VEHICLE FUEL ECONOMY

Fuel economy results are a byproduct of emissions testing, and EPA's pre-production emissions program is a convenient test point.

- EPA reviews all fuel economy testing calculations, confirms test data, and reports final CAFE results to DOT.
- EPA sets procedures for manufacturers to generate new vehicle fuel economy labels. EPA generates the annual Gas Mileage Guide, which is printed and distributed by DOE.
- EPA reports information on vehicles eligible for the Gas Guzzler tax to the IRS, which collects the tax from the manufacturers.

TRANSPORTATION AND GLOBAL WARMING

President Clinton has pledged to stabilize greenhouse gas emissions at 1990 levels by 2000, and asked for an Action Plan by August. Achieving these goals may require new transportation policies.

The U.S. transportation system contributes significantly to U.S. greenhouse gas emissions

Cars and light trucks emit 20% of U.S. CO₂ emissions, and significant proportions of the greenhouse gases—GHGs— N₂O, NO_x, CO, and NMVOCs. (The rest of the transportation sector emits another 10% of U.S. CO₂, and varying amounts of other GHGs.) The oil used by the U.S. transportation sector contributes roughly 5% of world CO₂ emissions, and 2.5% of total world greenhouse gas emissions.

Multiple benefits from reducing GHG emissions

Policies to reduce transportation energy use for global warming reasons are generally said to have multiple benefits:

- Reduce oil use for national security reasons
- Reduce congestion
- Reduce health and other damage from air pollution.

Transporting goods and people uses 63% percent of the oil burned in the U.S.

	Mobile Source GHG Emissions					
	CO ₂	CH ₄	N ₂ O	NO _x	CO	NMVOC
Car and light truck % of U.S. emissions	20.3%	0.7%	15.5%	16.1%	54.4%	30.1%
Total transportation % of U.S. emissions	29.6%	0.8%	16.4%	29.0%	60.8%	33.3%

GHG MITIGATION STRATEGIES THAT MAY AFFECT THE AUTO INDUSTRY

Three ways to reduce transportation sector GHG emissions:

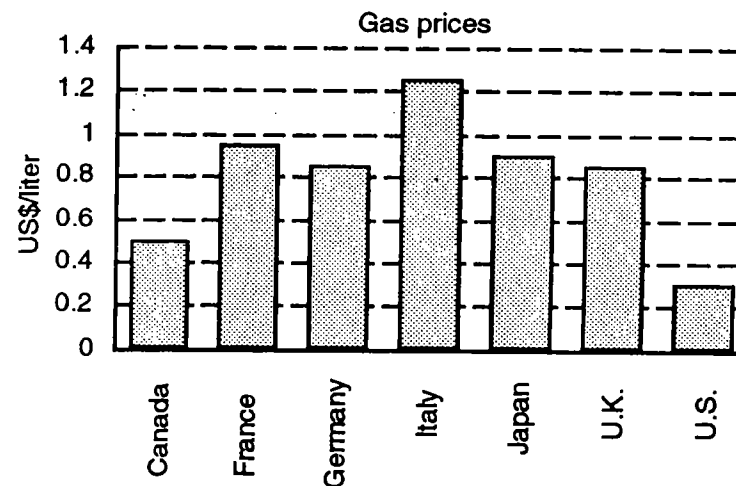
- 1) Improve the fuel efficiency of vehicles;
- 2) Convert to alternative fuels which produce fewer GHGs.
- 3) Switch to more energy-efficient ways of travel or drive less;

These approaches must combat trends which lead to increasing GHG emissions:

Low cost of driving

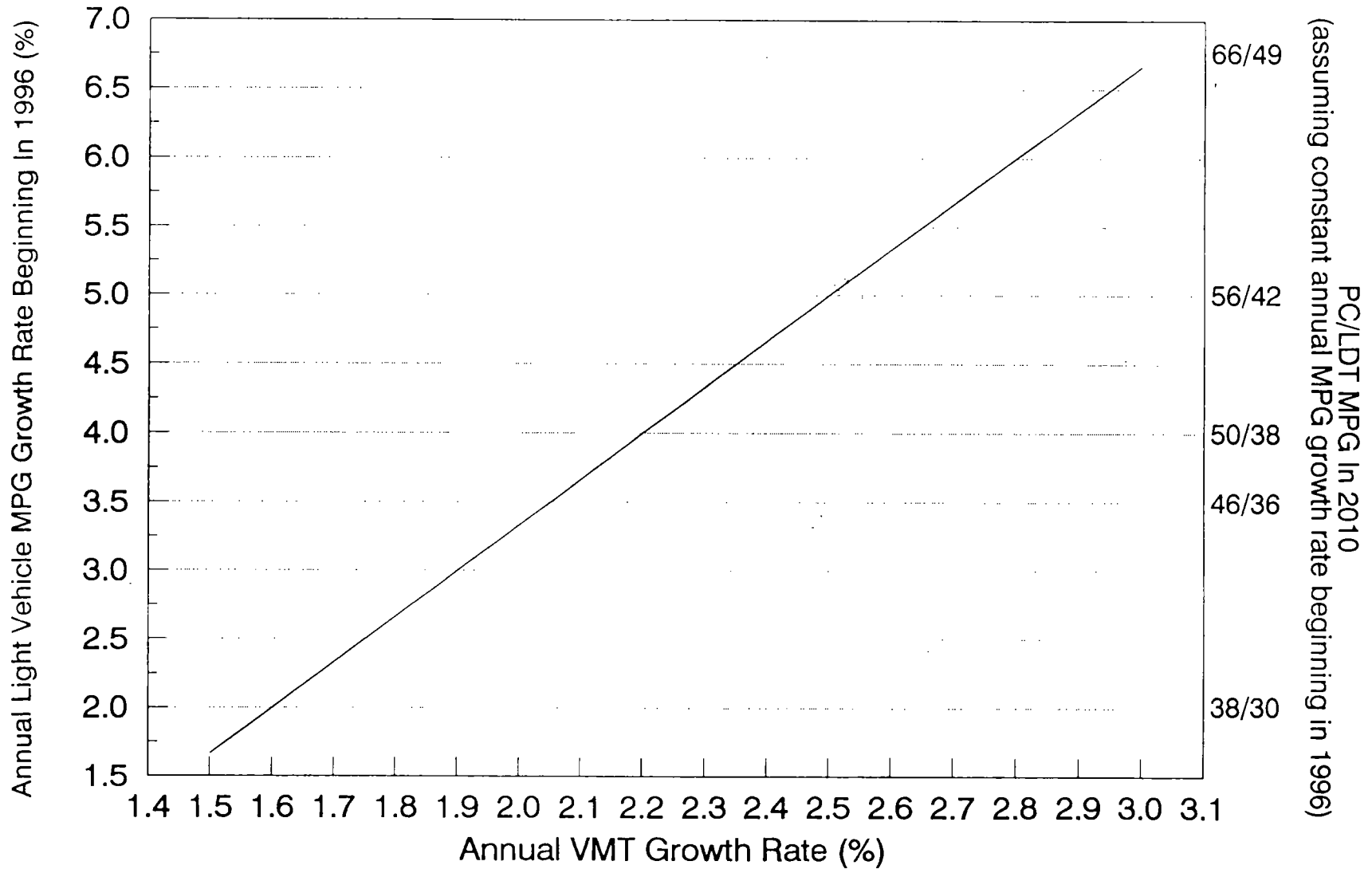
Drivers respond to a compelling set of incentives:

- Gasoline prices that are the lowest in the industrialized world
- Falling cost-per-mile: falling real fuel prices combine with increasing fuel efficiency to produce the record low cost-per-mile.
- Free parking; employee parking is subsidized by tax policy. 90% of Americans park free.
- "Free" roads; nationally, road building and maintenance is 60% paid for by user fees; 40% subsidized by general taxes.



LIGHT VEHICLE FUEL CONSUMPTION

2010 = 1980



IMPACT OF THE CFC PHASEOUT ON MOTOR VEHICLE A/C UNITS

- CFC production must be phased out by January 1, 1996. Recently, DuPont announced it will halt production by January 1, 1995.
- Motor vehicles are largest users of CFC-12 in the U.S. Auto companies are concerned about not having enough CFC-12 to service existing systems.
- 100% of 1994 vehicles will have new a/c systems, a few imports are already 100% CFC free. The new systems use HFC-134a, a non-ozone-depleting chemical.
- Recycling helps but because of leakage, additional CFC-12 is needed.
- Retrofits to HFC-134a are being developed but will not be "drop in" replacement - the chemical works at higher pressure and requires a different lubricant.
- Costs estimated to range from \$200 (newer cars) to \$800.
- EPA and auto industry have formed the Ad-Hoc Committee on Retrofit which will focus on consumer and technician education, and additional EPA rulemaking that may be necessary.

PROGRAMS AFFECTING EMISSIONS FROM AUTO FACTORIES

Air

- New Source Review (NSR) is required when a new factory is constructed or when an existing facility undergoes a "physical or operational" change which increases emissions.
- Currently, NSR covers emissions from surface coating operations, i.e. painting.
- To receive an operating permit in an attainment area, a facility must demonstrate that its new emissions will not contribute to a violation of any air quality standard.
- To receive a permit in a nonattainment area, a facility must "offset" its new emissions. Depending on the nonattainment classification of the area, offsets range from 1.1 to 1 up to 1.5 to 1.

Other Media

- Auto plants must meet effluent standards for wastewater discharge and storage and disposal requirements for hazardous materials.

INTERNATIONAL COMPETITIVENESS ISSUES

Vehicle emission requirements apply to all vehicles sold in U.S. so no competitiveness issues arise.

Auto companies are concerned, however, about stringent requirements imposed by the U.S. on factory emissions.

They most often cite paint operations at assembly plants. Other countries do not control fumes as the U.S. does and this allows foreign manufacturers to achieve higher gloss finishes.

EPA is chairing a workgroup, including State Dept., DOE, DOC, USTR and DOD, which is preparing a report to Congress on environmental competitiveness issues . A draft should be ready for public review in late summer. The domestic auto companies have prepared their own report.

TECHNOLOGY INITIATIVES BETWEEN EPA'S OFFICE OF MOBILE SOURCES AND THE AUTO INDUSTRY

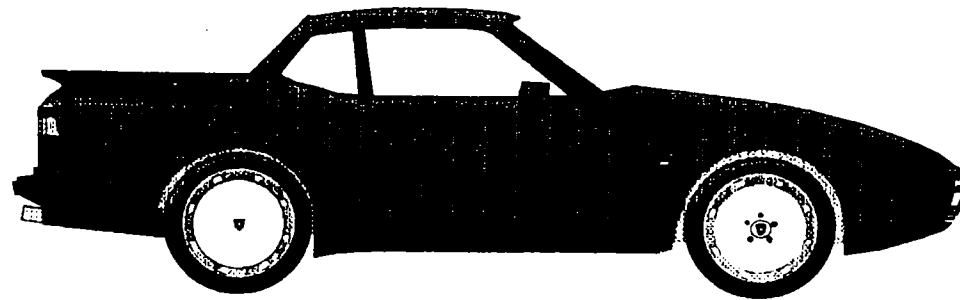
The Office of Mobile Sources (OMS) and its National Vehicle and Fuel Emissions Laboratory (NVFEL) regularly pursue technology-transfer initiatives with automakers and parts suppliers. High-tech innovations that are of interest to EPA for their air quality benefits often can provide competitive (as well as regulatory) advantages to manufacturers.

Examples are:

- Electrically heated catalysts
- A 1986 settlement between EPA, General Motors, and two public interest groups resulted in Detroit Diesel Corporation's 1991 certification of the world's first methanol-fueled engine.
- Agreement with GM for transfer of technology related to alcohol-fueled vehicles
- New catalyst technology for natural gas-fueled vehicles.
- Potential cooperative agreements with domestic companies to commercialize two-stroke engines that operate on alcohol fuels.
- Cooperative programs with small engine manufacturers to establish baseline emissions profiles for nonroad engines and vehicles.
- CRDA with the California Air Resources Board and major domestic manufacturers to develop technology for measuring and characterizing the emissions from extremely clean vehicles.
- Working on several advanced technologies to improve auto fuel efficiency.



INCENTIVES AND THE CAR



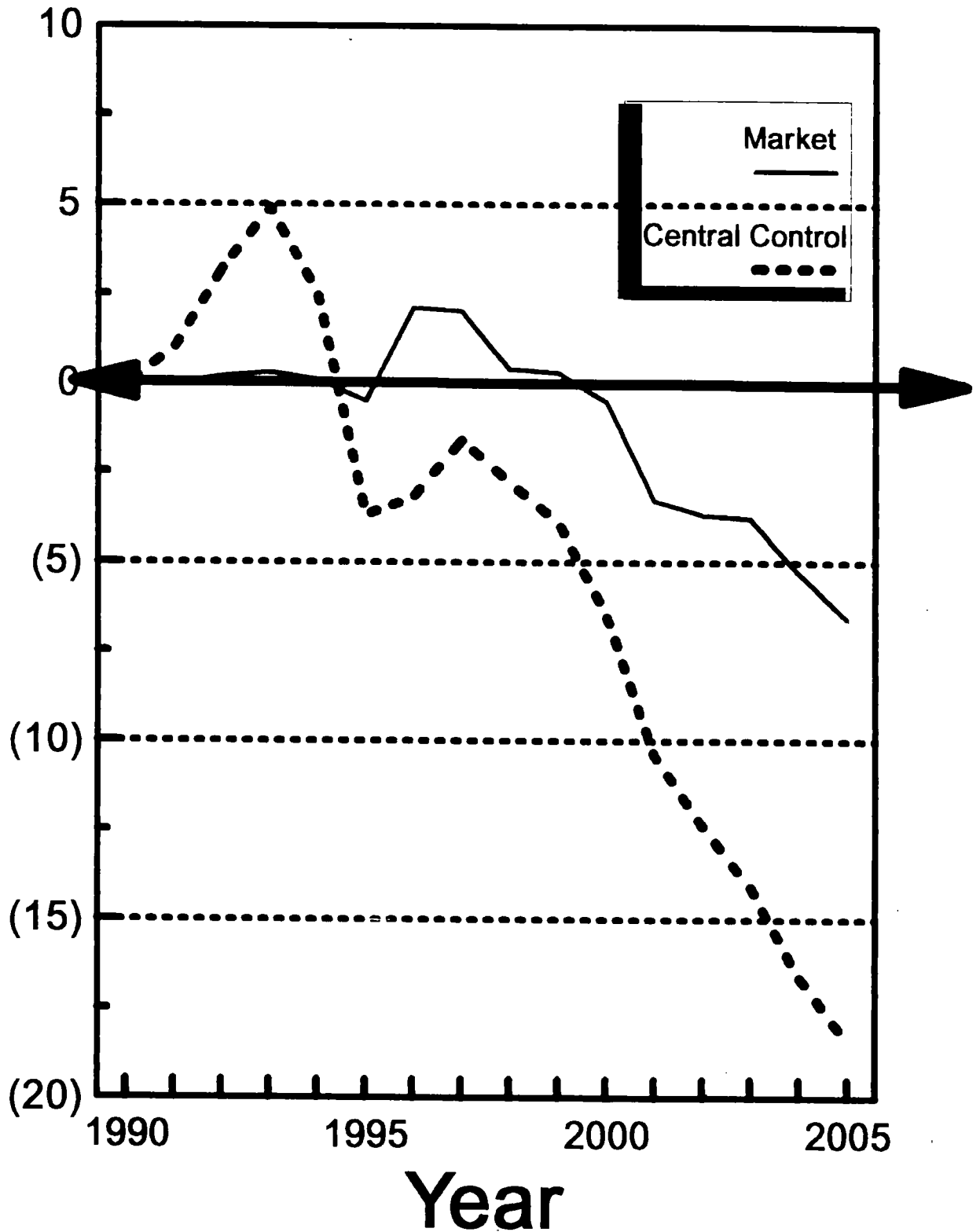
Daniel J. Dudek
Environmental Defense Fund



REAL GNP

(change from no policy)

Billions of 1982 Dollars



OVERVIEW

- **The Setting**
- **The Link Between
Competitiveness and
Environmental Policy**
- **Environmental Constraints on
the Transportation Industry**

THE SETTING

- ▣ Stationary and Mobile sources managed independently
- ▣ Aggregate Vehicle Emissions largely uncontrolled
- ▣ Federal Test Procedure uses unrealistic drive cycles
- ▣ Off-cycle Emissions may be significant
- ▣ High Emitting Vehicles likely significant source of Emissions
- ▣ Evaporative Emissions highly variable
- ▣ Vehicle Miles Traveled a huge determinant of loadings

COMPETITIVENESS & ENVIRONMENTAL POLICY

▣ COST

command-and control vs the market

▣ TECHNOLOGY

continuous innovation

▣ COMPETITION

in environmental terms?

▣ INVESTMENT

in most efficient approach

ENVIRONMENTAL POLICIES AFFECTING VEHICLES

▣ Command-and-Control: The Current Regulatory Regime

- * Tailpipes & Fuel Systems**
- * Safety**
- * Fuel Efficiency**



ECONOMIC INCENTIVES APPLIED TO VEHICLES

▣ Taxes and Fees

- * Fuels**
- * Excise**
- * Congestion**
- * Emissions**

EDF

Voluntary Action

- * Product Labeling
- * Unusual Coalitions

Emission Reduction Crediting

- * Diesel Engine Emissions
- * Recall Offsets
- * Mobile Emission
Reduction Credits

MOBILE EMISSION REDUCTION CREDITS

Political yield is environmental, not new car sales

Expand emissions trading

- remove barriers between mobile and stationary sources

- integrate Title I and Title IV programs

- create a performance-based Nonattainment Program

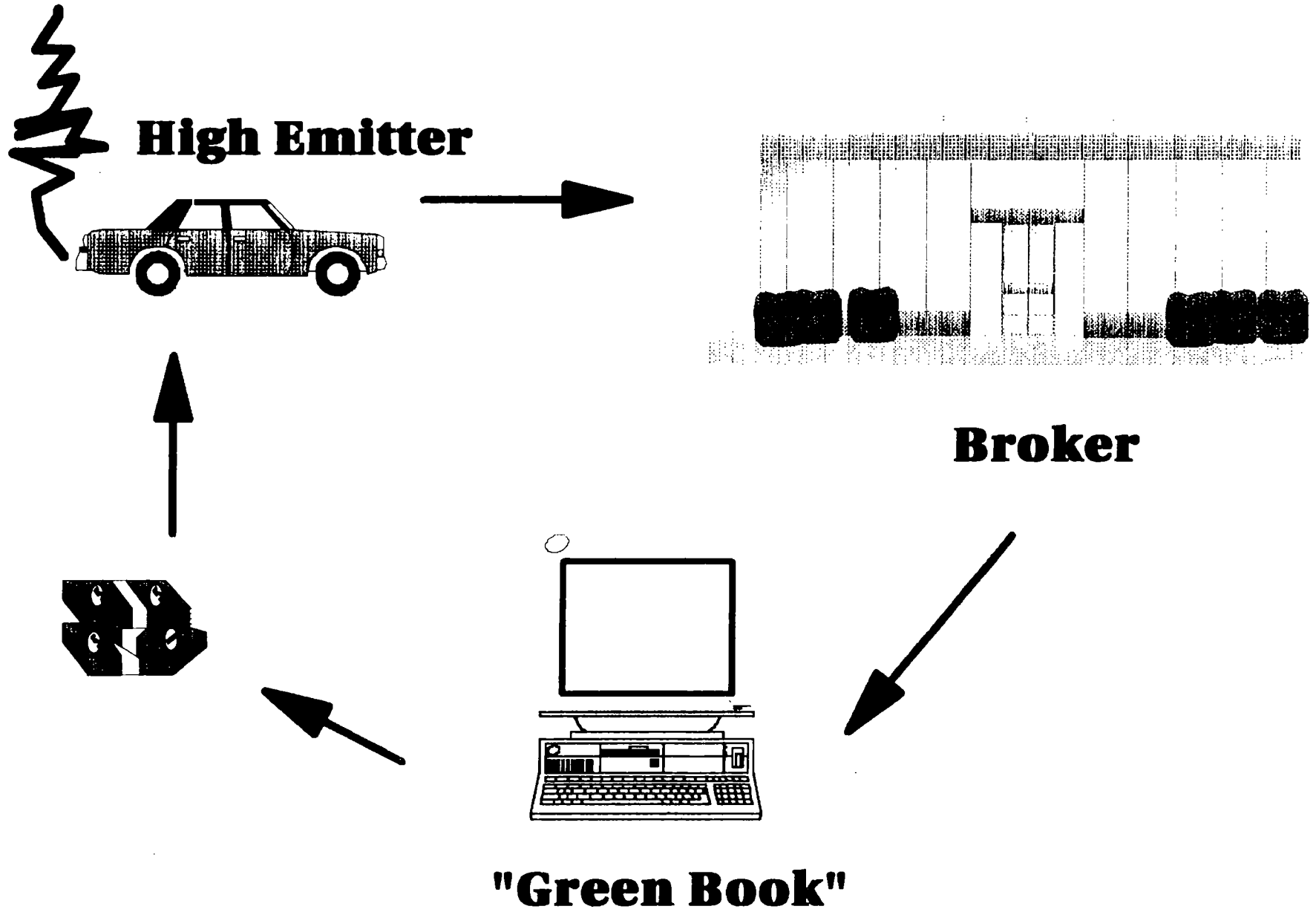
Refocus from "clunkers" to emissions

- create currency with integrity

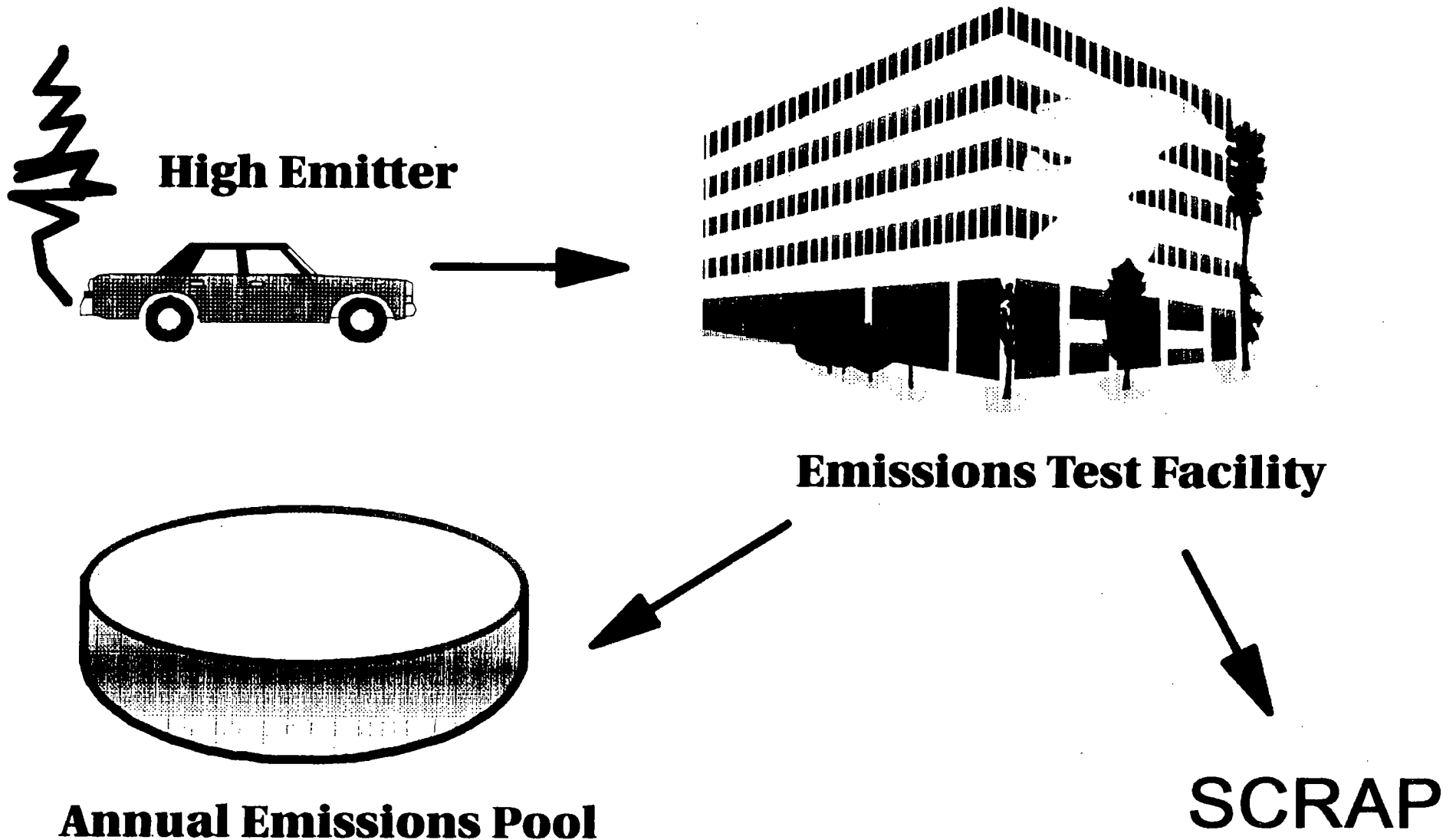
- create positive investment climate

- widen the range of emission reduction options

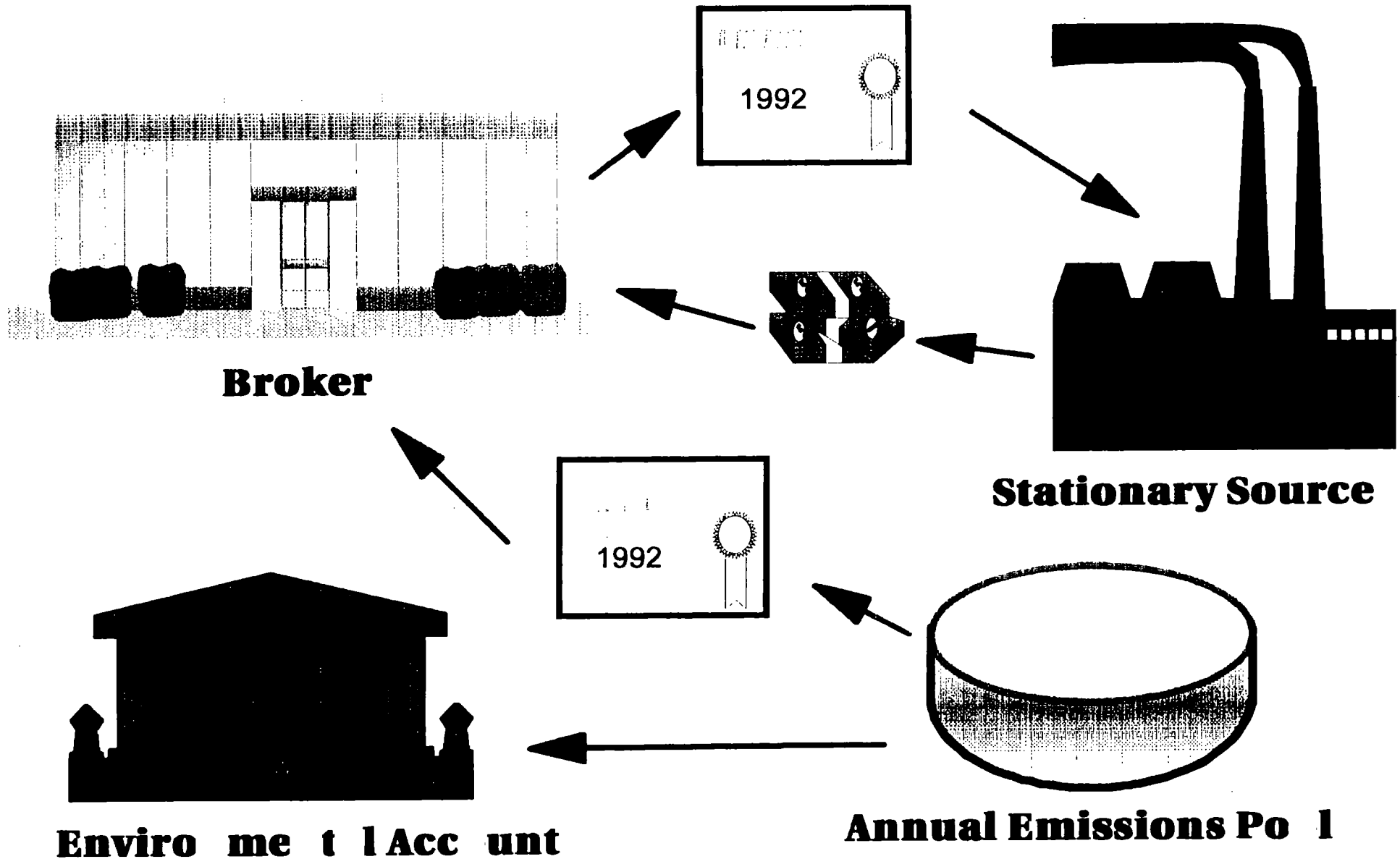
Step One: Target & Acquisition



Step Two: Measurement



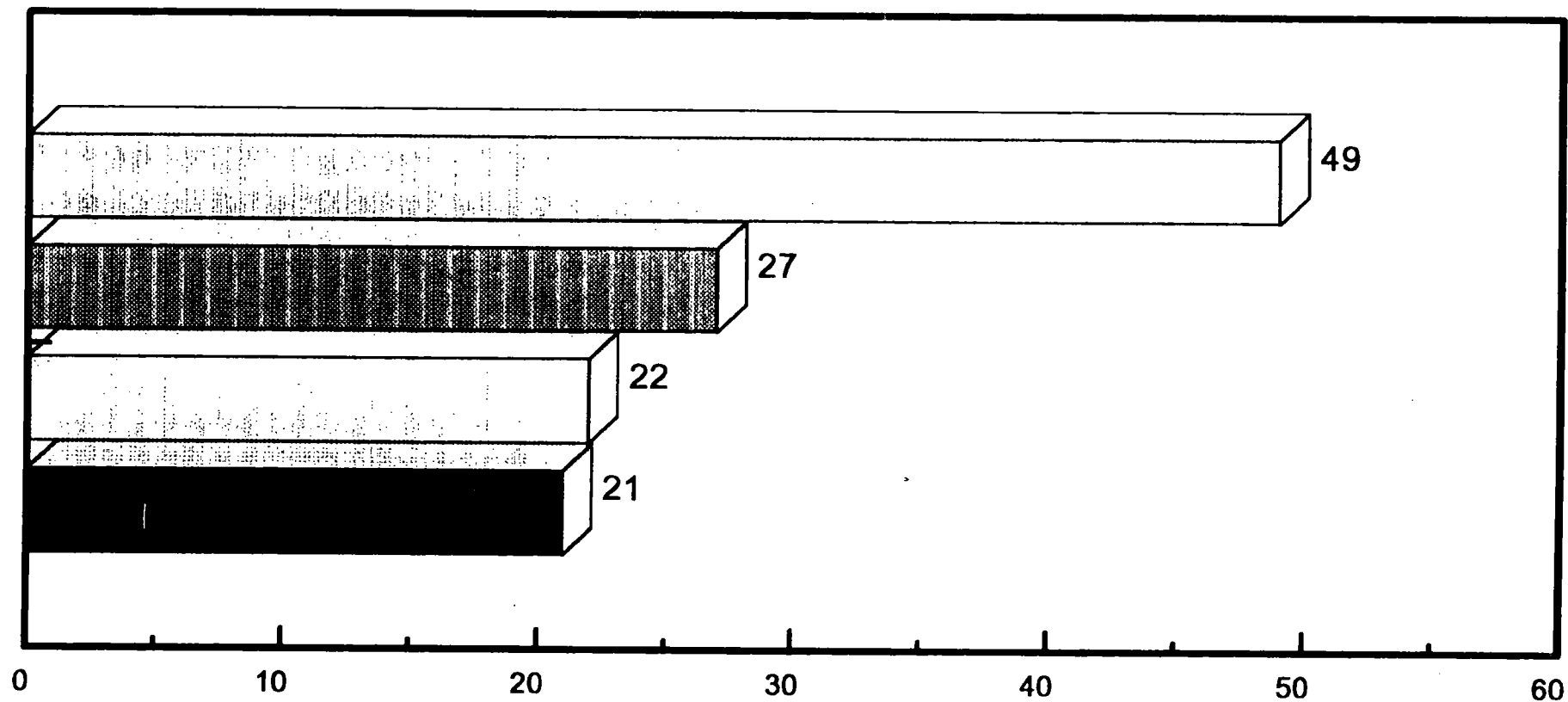
Step Three: Disposition



ECONOMIC FEASIBILITY OF MERCs

	Hydrocarbon Emissions	Tons of HC @ 23,000	Emissions Value
Typical UNOCAL	24.8	0.57	\$1,711
Replacement Vehicle	2.53	0.06	\$175
Net	22.27	0.51	\$1,537
	NO_x Emissions	Tons of NO_x @ 23,000	Emissions Value
Typical UNOCAL	2.94	0.07	\$203
Replacement Vehicle	1.13	0.03	\$78
Net	1.81	0.04	\$125

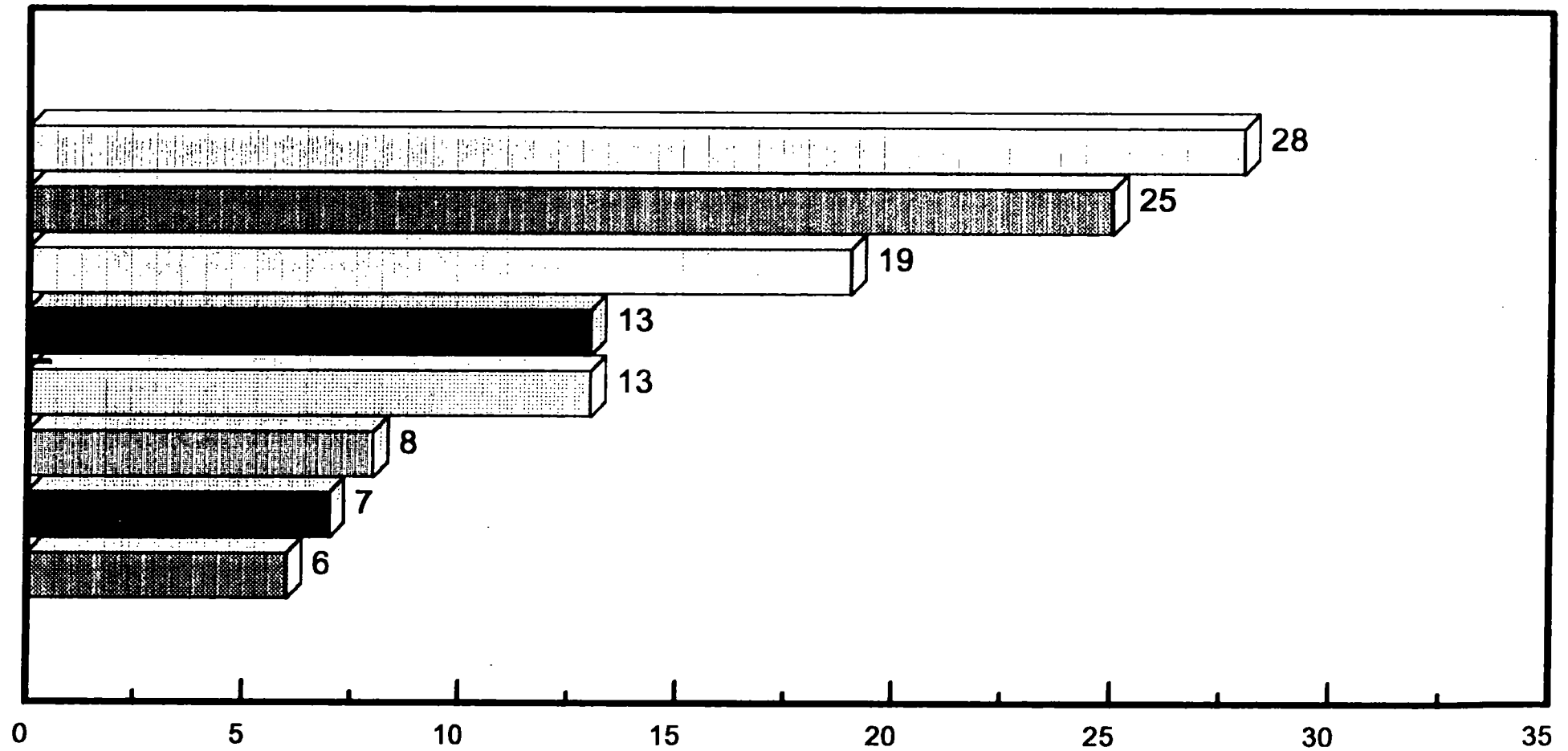
REASONS FOR FAVORABLE OPINION



☐ Reduce Pollution
☐ Old Cars Major Source

☒ Good Incentive
☒ Good Way to Remove Old Cars

REASONS FOR UNFAVORABLE OPINION



Can't Afford Newer

Not Really Voluntary

\$1000 Too Little

Gov't Can't Afford

Small Part Problem

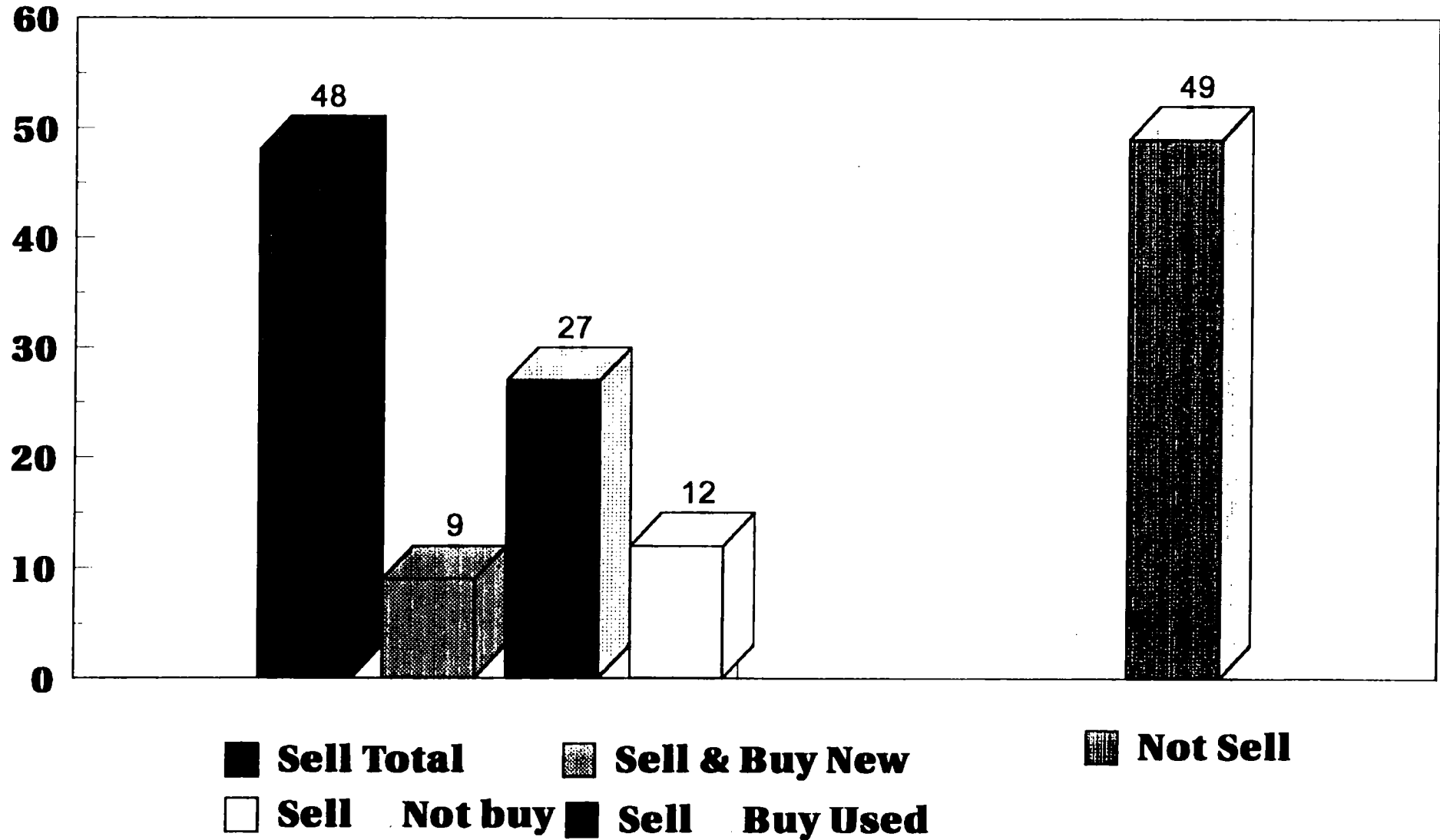
Old Cars Go Away

\$1000 Too Much

Gov't Shouldn't Do

PLANS TO PARTICIPATE

percent



THE FUTURE

▣ Mobile Sources and Global Warming

International Trade and
Environmental Commodities

▣ Comprehensive Vehicle
Emissions Reductions

COMPREHENSIVE FUTURE

- ▣ Develop Emission Reduction Credit Banks
- ▣ Build toward Vehicle Emissions Trading
- ▣ Extend and Expand the use of Offsets
- ▣ Break down artificial air quality management barriers
- ▣ Substitute Environmental Performance for Modeling and Discretion

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BACKGROUND CONDITIONS

- **TRANSITION FROM “MASS” TO “LEAN”**
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- **MORE DURABLE PRODUCT**
- **LARGE TRADE DEFICIT**
- **EMERGING WORLD OF REGIONS**

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EXAMPLES OF LEAN

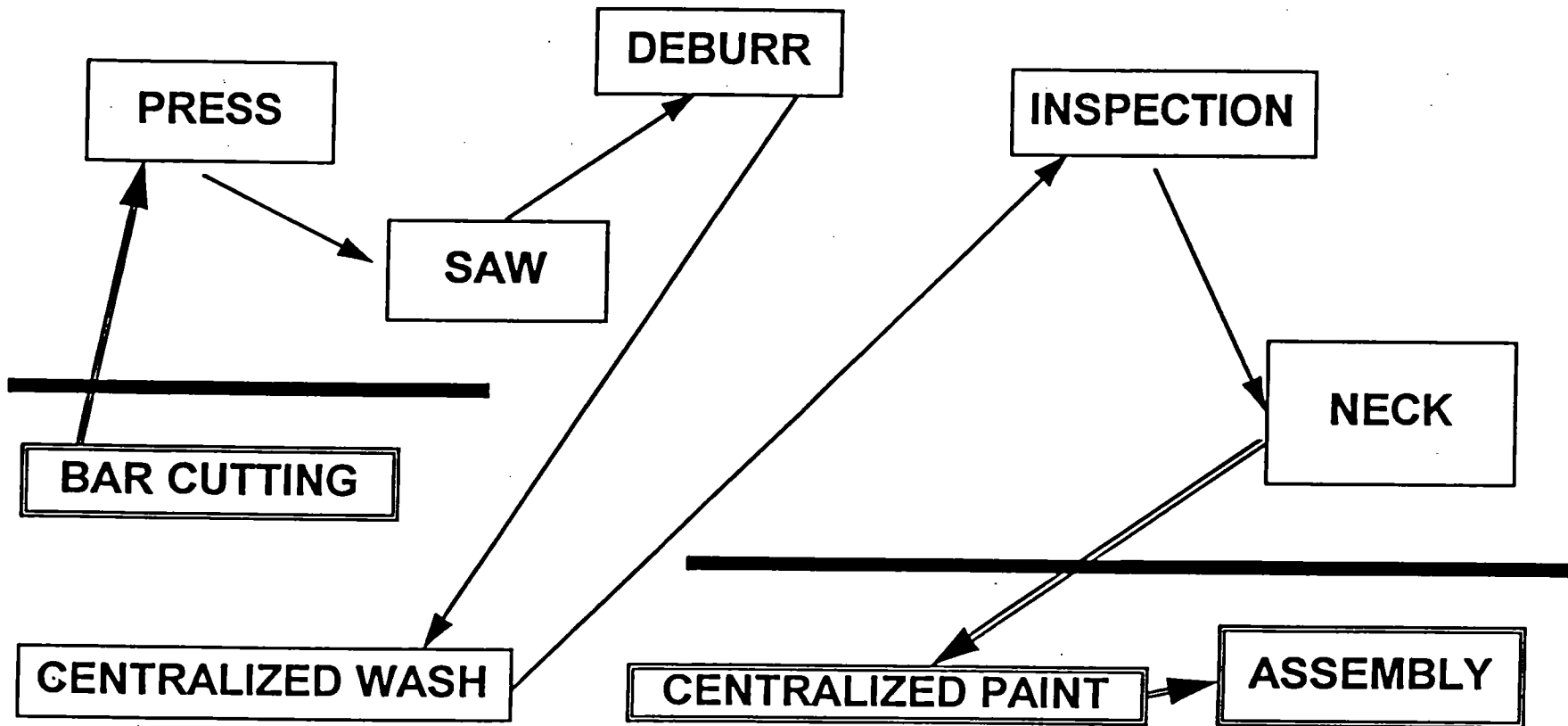
- **FIXING A SINGLE PROCESS**
- **FIXING A FACTORY**
- **FIXING PRODUCT DEVELOPMENT**
- **FIXING THE SUPPLY CHAIN**

LEAN PRINCIPLES:

- **IDENTIFY KEY VALUE STREAMS**
- **OPTIMIZE THE TOTAL VALUE STREAM**
- **STANDARDIZE ALL PROCESSES**
- **MAKE VALUE STREAMS TRANSPARENT**
- **CALCULATE COSTS FROM BOTTOM UP**
- **RECOMBINE LABOR TO CREATE FLEXIBILITY AND ELIMINATE INDIRECT WORK**
- **ASSIGN WORK AND DECISION MAKING TO LOWEST APPROPRIATE LEVEL**

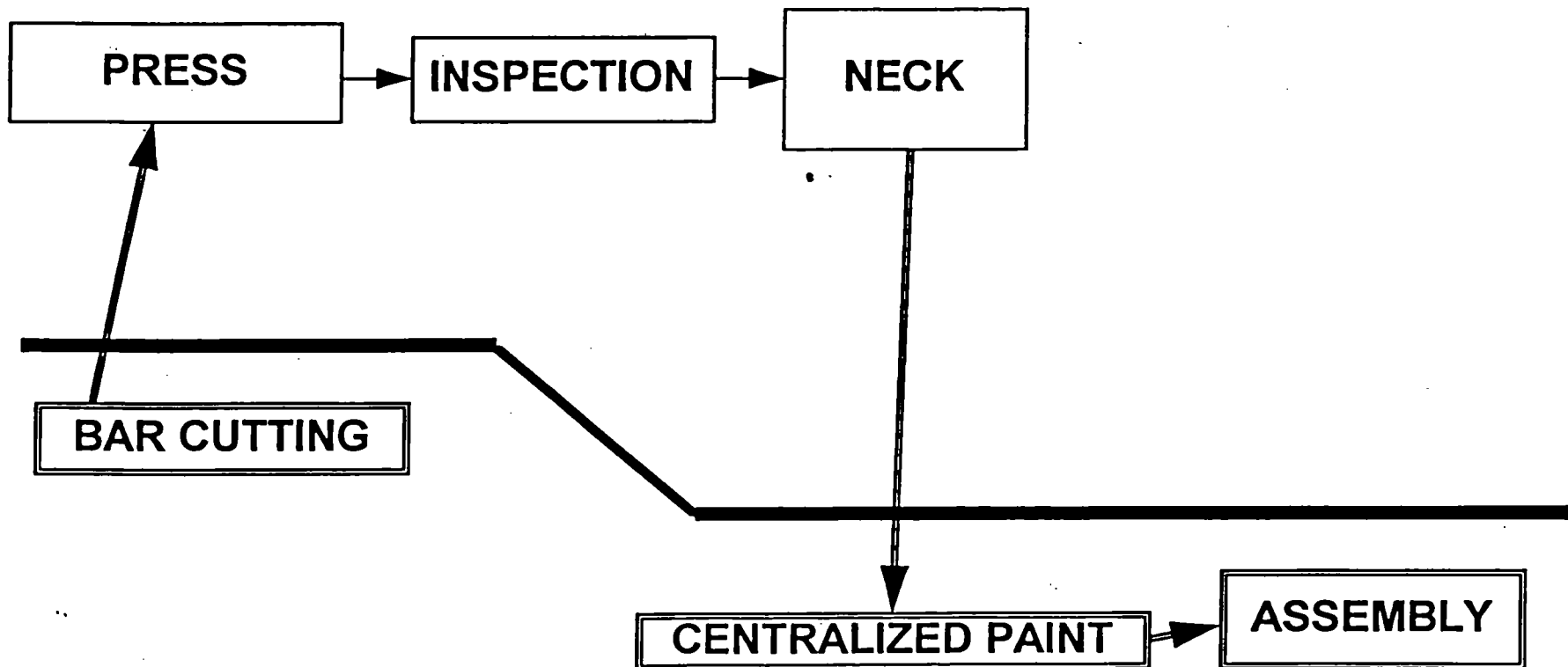
ALUMINUM PRESSURE TANK

PROCESS BEFORE HONDA BP:



ALUMINUM PRESSURE TANK

PROCESS AFTER HONDA BP:



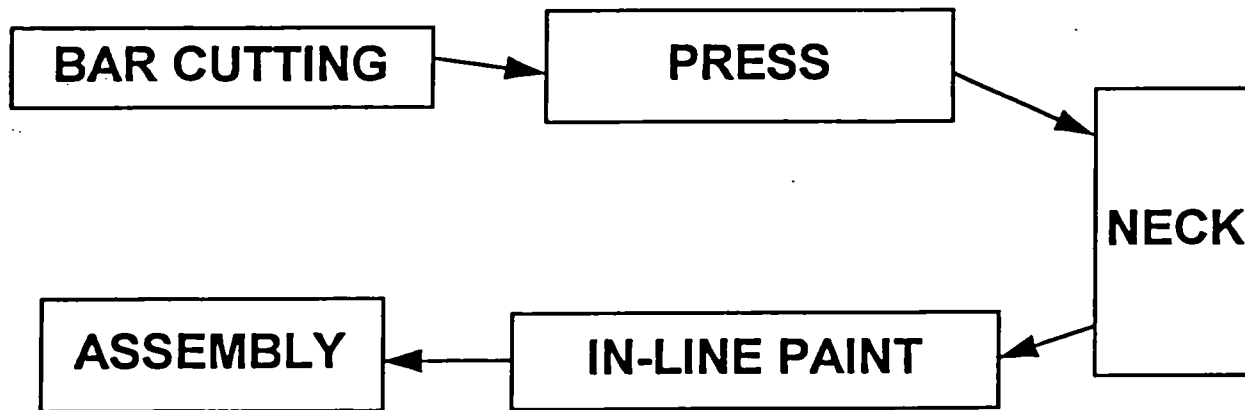
ALUMINUM PRESSURE TANK PLANT:

LEAN TECHNIQUES APPLIED TO SINGLE OPERATION: TANK EXTRUSION & NECKING

<u>PERFORMANCE MEASURE</u>	<u>BEFORE</u>	<u>AFTER</u>
PROCESSING STEPS	6	3
OPERATORS	10	3
SCRAP RATE (% OF PARTS)	5	1.8
DISTANCE IN PROCESS (FEET)	500	35
LINE BALANCE	47	92.4
TIME IN PROCESS	19 DAYS	3.2 MIN
NUMBER OF PIECES IN PROCESS	1000	6
NUMBER OF BOX TRANSFERS	7	1
\$ SPENT TO IMPROVE PROCESS	\$7,826	
ANNUAL COST REDUCTION	\$60,062	
PERCENTAGE COST REDUCTION	8.0	

ALUMINUM PRESSURE TANK

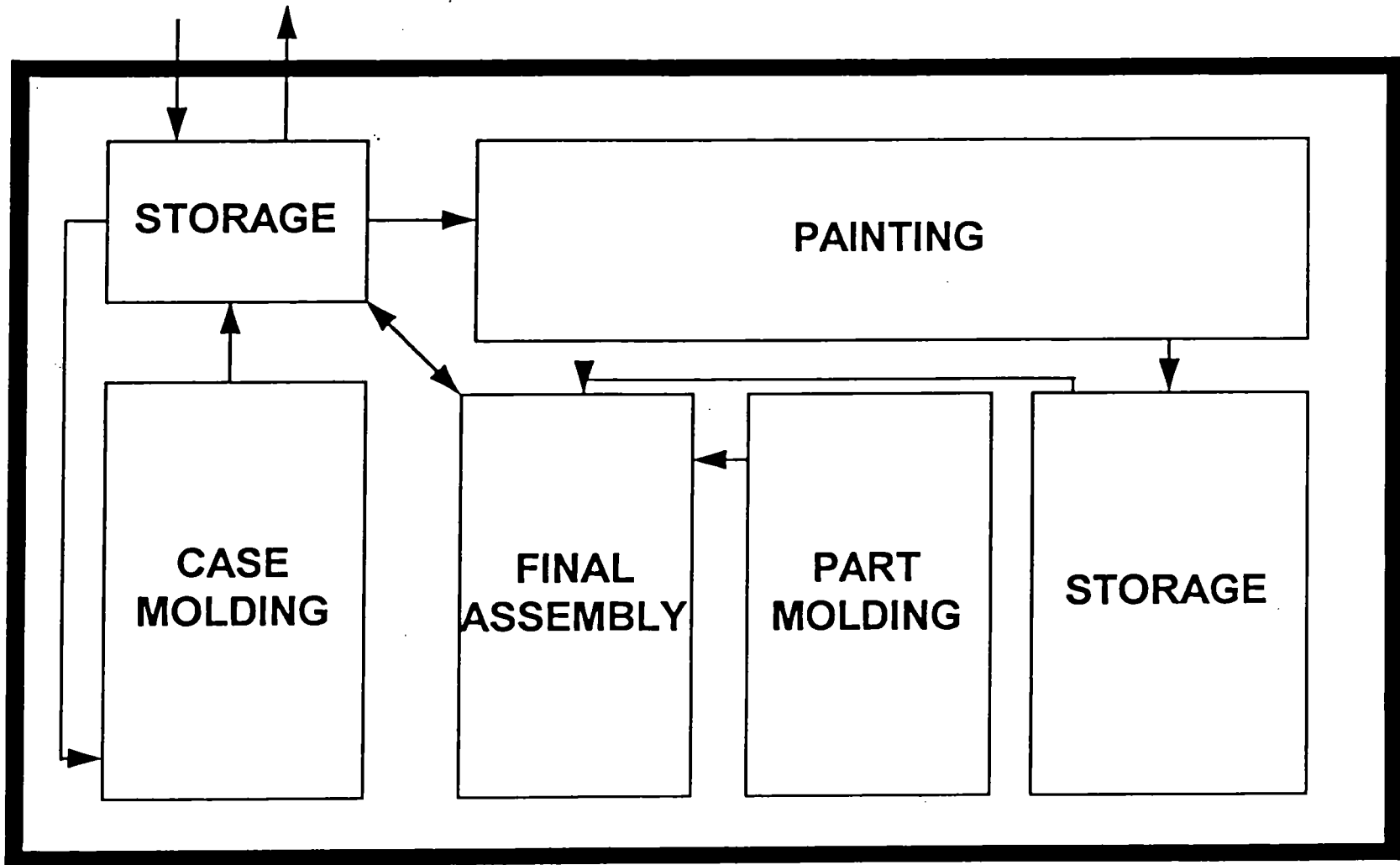
FUTURE CONFIGURATION?



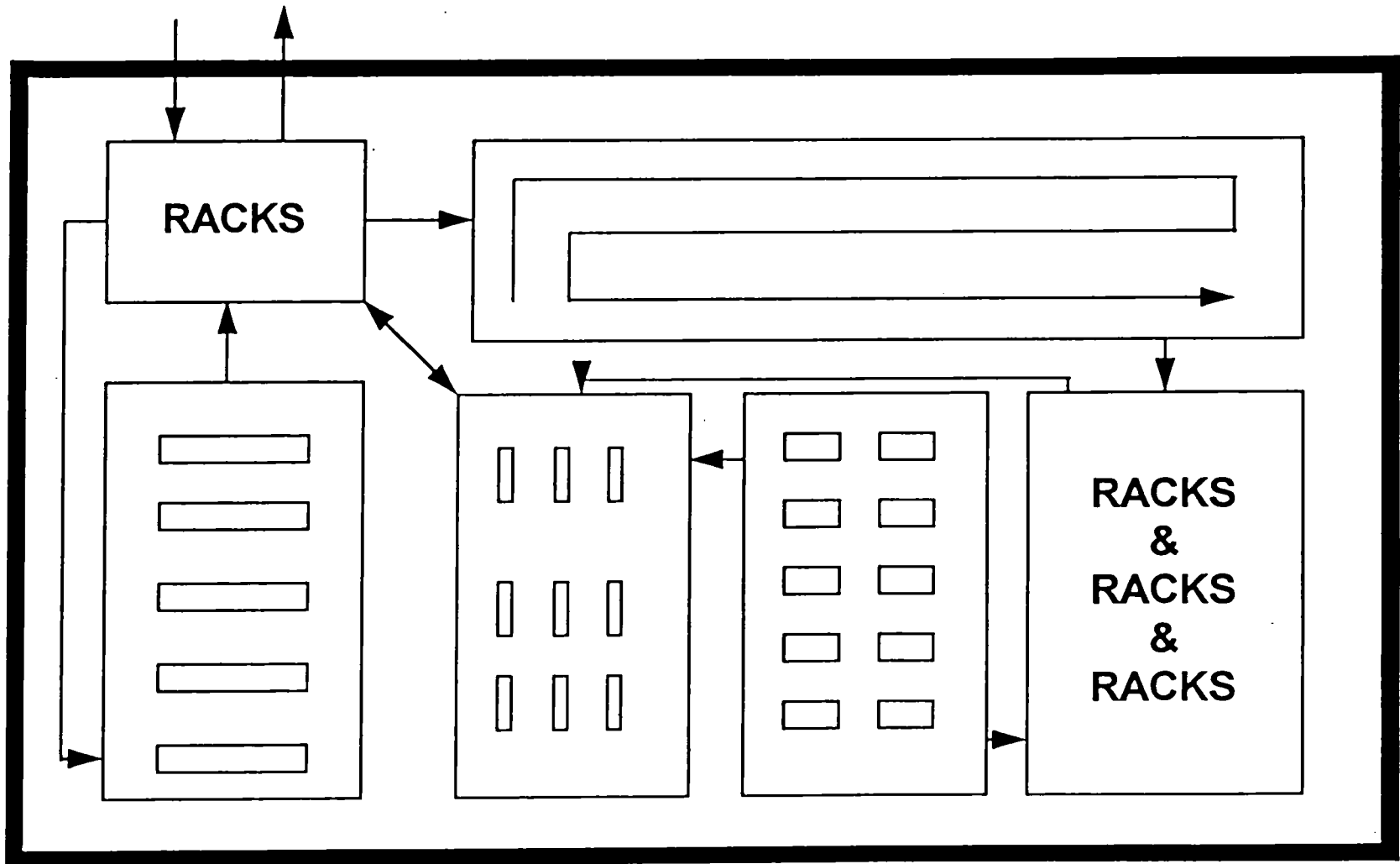
WHAT PRINCIPLES ARE BEING APPLIED IN THIS CASE?

- **CREATE A CONTINUOUS FLOW FOR ENTIRE VALUE STREAM**
- **MAKE THE VALUE STREAM TRANSPARENT**
- **MAKE THE EQUIPMENT SIMPLE & FLEXIBLE**
- **REMOVE ALL EXCESS: SPACE, STEPS, HUMAN EFFORT**
- **STANDARDIZE ALL ASPECTS OF PROCESS**
- **LET LINE MANAGEMENT AND WORKERS REMOVE IMPEDANCE, WITH ADVICE FROM THE INDUSTRIAL ENGINEERS**

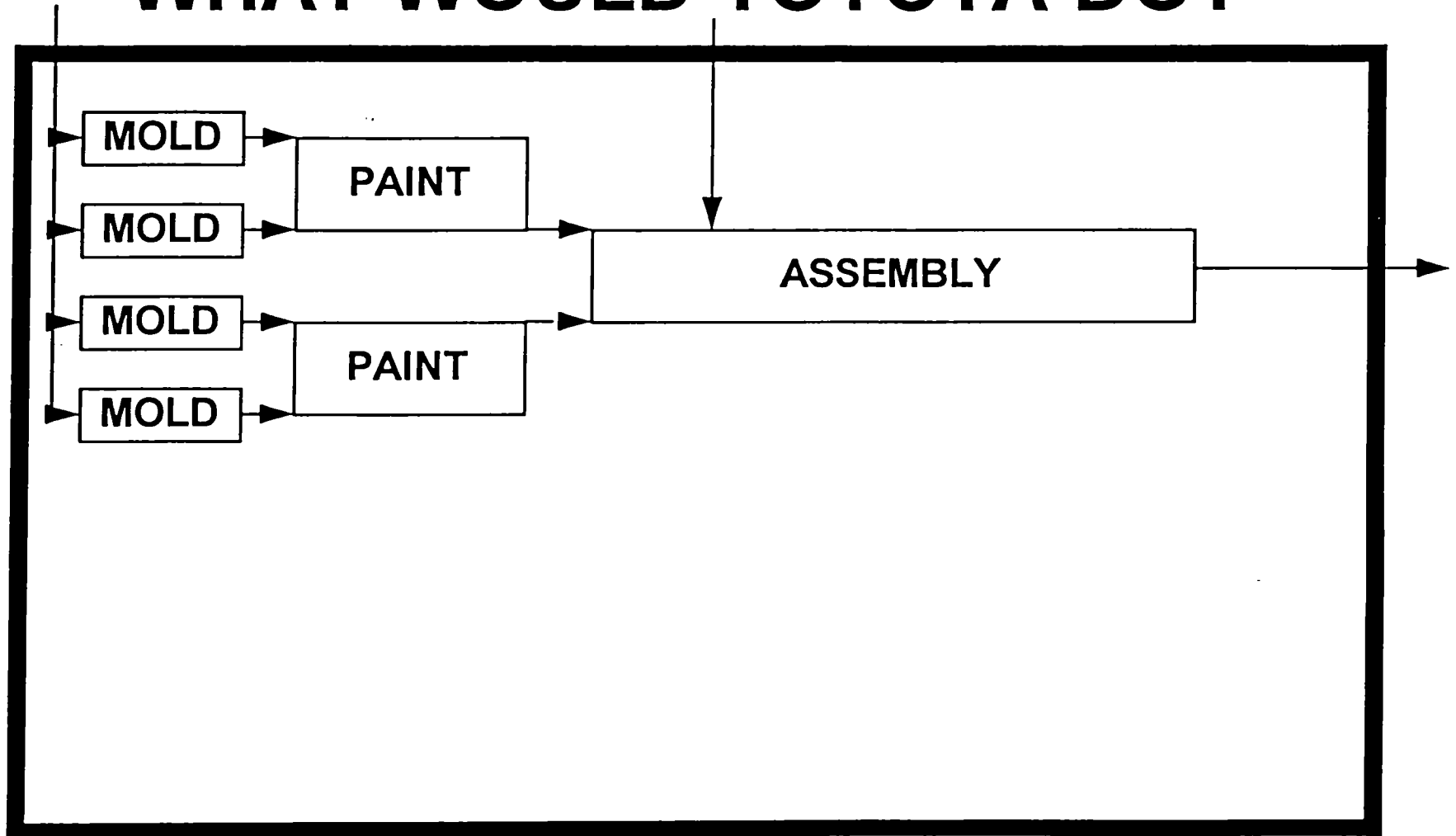
REARVIEW MIRROR PLANT



REARVIEW MIRROR PLANT



REARVIEW MIRROR PLANT: WHAT WOULD TOYOTA DO?



WHAT CAN BE DONE FIRST?

- **INTRODUCE JUST-IN-TIME WITHIN PLANT**
- **TEACH LINE MANAGERS & LINE WORKERS TO THINK ABOUT FLOW AND WAYS TO REMOVE IMPEDANCE**
- **KAIZEN EACH DISCRETE PROCESS IN CURRENT LAYOUT**
- **MAKE ALL PROCESSES FULLY CAPABLE**
- **INTRODUCE QUICK TOOL CHANGES**
- **REPLACE EXPENDABLE PACKAGING & RACK PARTS FOR TRANSPARENCY**

WHAT CAN BE DONE NEXT?

- **DEVELOP OUTSIDE SUPPLIERS TO MAKE SMALL PARTS & DELIVER JIT**
- **DEVELOP MINI-PAINT BOOTH TECHNOLOGY TO PERMIT IN-LINE PAINTING**
- **REDESIGN MOLDED PARTS TO ELIMINATE MOLDING PROBLEMS AND EASE PAINT & FINAL ASSEMBLY**
- **MULTI-SKILL WORKERS & MANAGERS TO TAKEOVER INDIRECT TASKS**

WHAT ARE THE FINAL STEPS?

- **REALIGN ENTIRE PRODUCTION PROCESS TO CREATE CONTINUOUS FLOW**
- **MAKE STATUS OF THE SYSTEM VISIBLE TO EVERYONE**
- **REMOVE ALL EXCESS SPACE & PEOPLE (FIND MORE BUSINESS!)**
- **MAKE ALL EQUIPMENT MOVABLE (“IF YOU CAN’T MOVE IT, YOU CAN’T IMPROVE IT!”)**
- **BEGAN KAIZEN ACTIVITIES ON NEW LAYOUT!**
- **STRIVE FOR PERFECTION!**

CHRYSLER EXAMPLE:

JA CAR (FALL 1994):

- **3 YEARS FROM START TO JOB 1 (VERSUS 5+)**
- **700 ENGINEERS VS 1400 PREVIOUSLY**
- **40 % REDUCTION IN TOOL COSTS (DUE TO DFM)**
- **LOCATION OF TEAM IN ONE BUILDING; NO TURNOVER**
- **300 SUPPLIERS (VERSUS 2500) DOING HALF OF ENGINEERING**
- **ALL COMPONENTS TARGET PRICED ("NO BIDS IN CAR")**
- **ORGANIZATION DESIGNED TO REMOVE IMPEDANCE ("NEVER LET ORGANIZATION INTERFERE WITH WORK FLOW")**

SUPPLIER COORDINATION:

A RANGE OF IMPORTANT EXPERIMENTS:

- **CHRYSLER JA PROGRAM:**

- ROUGHLY 300 FIRST-TIER SUPPLIERS
- 100% PRE-SELECTION OF SUPPLIERS
- 100% TARGET PRICED
- 100% SOLE-SOURCED
- 100% LIFE-OF-THE-PRODUCT CONTRACTS
- MAJOR SUPPLIER PERSONNEL INTEGRAL PART OF DEVELOPMENT TEAM, STATIONED ON SITE

- **JAPANESE TRANSPLANTS:**

- MOVING FROM QUALITY TO “COST-DOWN” FOCUS AS NORTH-AMERICAN CONTENT RISES
- WIDESPREAD USE OF “SUPPLIER DEVELOPMENT TEAMS” TO PERFORM HANDS-ON MANUFACTURING SYSTEM UPGRADING IN SUPPLIER PLANTS

OBJECTIVES FOR A POLICY AGENDA

- **CREATE A MOTOR VEHICLE INDUSTRY
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- **DAMP THE CYCLICALITY WHICH
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- **CREATE A MOTOR INDUSTRY WHICH
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MEANS TO OBJECTIVES

- **ENCOURAGE FDI IN U.S. AS MEANS TO SPUR COMPETITION**
- **MAKE THIS PALATABLE BY NEGOTIATING “TRADE BALANCING” APPROACH TO DEFICIT REDUCTION**
- **ENACT THE NAFTA**
- **MAKE IT PALATABLE BY NEGOTIATING “TRADE BALANCING” APPROACH TO DEFICIT REDUCTION**
- **STABILIZE DEMAND WITH AMERICAN EQUIVALENT OF A “SHOKEN”**
- **PREVENT “GREEN MANDATES” FROM BECOMING COMPETITIVE BARRIERS**

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The Machine That Changed the World
 Jim Womack

Motor Vehicle Industry Calendar - As of May 4, 1993

	External- General	External- Auto	Treasury	Commerce	Labor	Transportation	Energy	EPA	Trade
Ongoing		California emissions standards, potential adoption by other states	Minivan tariff issue	Clean car initiative	(i) Reform of worker adjustment programs; (ii) reform of training for employed workers and of the school-to-work transition; (iii) pension reform	(i) Lt truck automatic restraints (MY95-98); (ii) mandatory air bags (cars MY97-98; lt trucks MY 98-99); (iii) mandate tougher dummy stds (MY97 proposed); (iv) lt truck roof strength (MY95); (v) rollover protection; (vi) upgraded fuel system protection standard; (vii) antitheft parts marking; (viii) car and light truck CAFE	(i) Clean car initiative; (ii) activities to support federal purchase of alt fuel veh; (iii) studies, programs, demonstrations, data collection, collaborative efforts, testing programs on alternative fuels	(i) Clean Air new source review; (ii) position in CA emissions litigation	Action plan for Japan, including autos and auto parts will be worked out after Miyazawa visit.
April 1993				(i) Meet with Congressional Auto Coalition staff; (ii) auto industry strategy meeting with big 3 CEOs.			(i) Propose rule establishing fuel economy equivalence of electric vehicles for CAFE; (ii) consumer info and assistance to FTC on alternative fuel vehicles and labeling; (iii) 5-year program plans on electric vehicles, advanced diesel emissions, advance diesel engine	Nonroad diesel emission stds proposed	
May 1993	Health Care	Meeting with Michigan delegation-5/11		Negotiation of public-private collaborative research efforts		Spring - Requirements, effective MY95, for manufacturers to label domestic content of cars and light trucks	(i) Quarterly mtg w/ automakers on alternative fuels; (ii) Clean Car Veh Conference, Exposition, Grand Prix, Atlanta, GA	(i) Emission stds and conversion reqs for Clean Air fleets program proposed; (ii) CA low emission pilot program proposal; (iii) initial review of Federal [emission] Test Procedure issued	

	External- General	External- Auto	Treasury	Commerce	Labor	Transportation	Energy	EPA	Trade
June 1993		6/23-25 - Start of UAW/big three collective bargaining.					Clean Cities Award to Philadelphia		Submission of NAFTA implementing legislation (tentative)
July 1993				Rollout of public-private collaborative research effort			(i) Begin solicitation for acq. of alternative fuel veh for fedl fleet (11,000+ for FY94); (ii) select proposals to accelerate near- and mid-term development of passenger and hybrid vehicles (EPAct 2022)	Final rule on diagnostics to indep. repair facilities	
August 1993							(i) Complete fabrication and continue eval of 10Kw PEM breadboard fuel cell system; (ii) hybrid vehicle contract award(s) announced; (iii) report to Congress on purchasing policies of Fed Govt which inhibit or prevent fedl purch of alt fuel veh; (iv) issue proposed draft guidelines to fedl agencies to measure alt fuels in hybrid fleet (EPAct 308); (v) solicit proposals for advanced diesel emissions program (EPAct 2027); (vi) grants to states for use on programs related to heavy duty alt fueled vehicles	Clean Air proposed rules more rigorous monitoring for large pollution sources	

	External- General	External- Auto	Treasury	Commerce	Labor	Transportation	Energy	EPA	Trade
September 1993	Reconciliation completed	9/1 - UAW picks strike target; UAW contracts expire 9/14 9/93-9/94 - UAW contracts with auto parts manufacturers expire.			Probable release of pension reform legislative proposal			(i) Final rules req clean burning gasoline beg in 1995 in high pollution areas; (ii) Establishment of tailpipe stds for natural gas vehicles	
October 1993						MY94 items: (i) 10% of car fleet to meet dynamic side impact stds (all by MY97); (ii) 90% lt trucks to meet static side impact stds (all by MY95); (iii) light truck third brake lamp; (iv) light truck CAFE of 20.5 mpg	(i) Solicit proposals for (a) electric vehicle infractrusture research and demonstration, (b) advance diesel emissions program, (c) high efficiency heat engines; (ii) publish NPRM on guidelines for state alternative fuels and alternative fuel vehicles incentives and plans (EPAct 409); (iii) select proposals for R&D coop agreements for electric motor vehicles		
November 1993	States req to develop operating permit programs for air pollution sources, can charge annual fees for emissions						(i) Fuel cell proof-of-concept bus testing begins; (iii) info and tech asst programs to promote alt fuel vehicles in Fedl agencies (EPAct 305); (iii) distribute gas mileage guide	Final rule on on-board vapor control devices for 1998+	

	External- General	External- Auto	Treasury	Commerce	Labor	Transportation	Energy	EPA	Trade
December 1993						ANPRM on car anti-lock brakes	(i) Materials on alternative fuels and vehicles for consumers (EPAct 405); (ii) hearings on proposed guidelines for State alternative fuels and alt fueled vehicles incentives and plans (EPAct 409); (iii) submit to Congress 5-year program plan for technologies to reduce oil and gas demand for transportation (EPAct 2021)	Proposed rules to control emissions of toxic air pollutants from new or modified facilities	
January 1994	FY 1995 budget						(i) Acquire voluntary commitments from fuel and vehicle suppliers and fleet owners to provide and use alternative fuel vehicles and fuels; (ii) issue rule on alcohol fuels and cold start requirements		Projected NAFTA implementation.
February 1994									
March 1994									
April 1994									