INDUSTRY CANADA

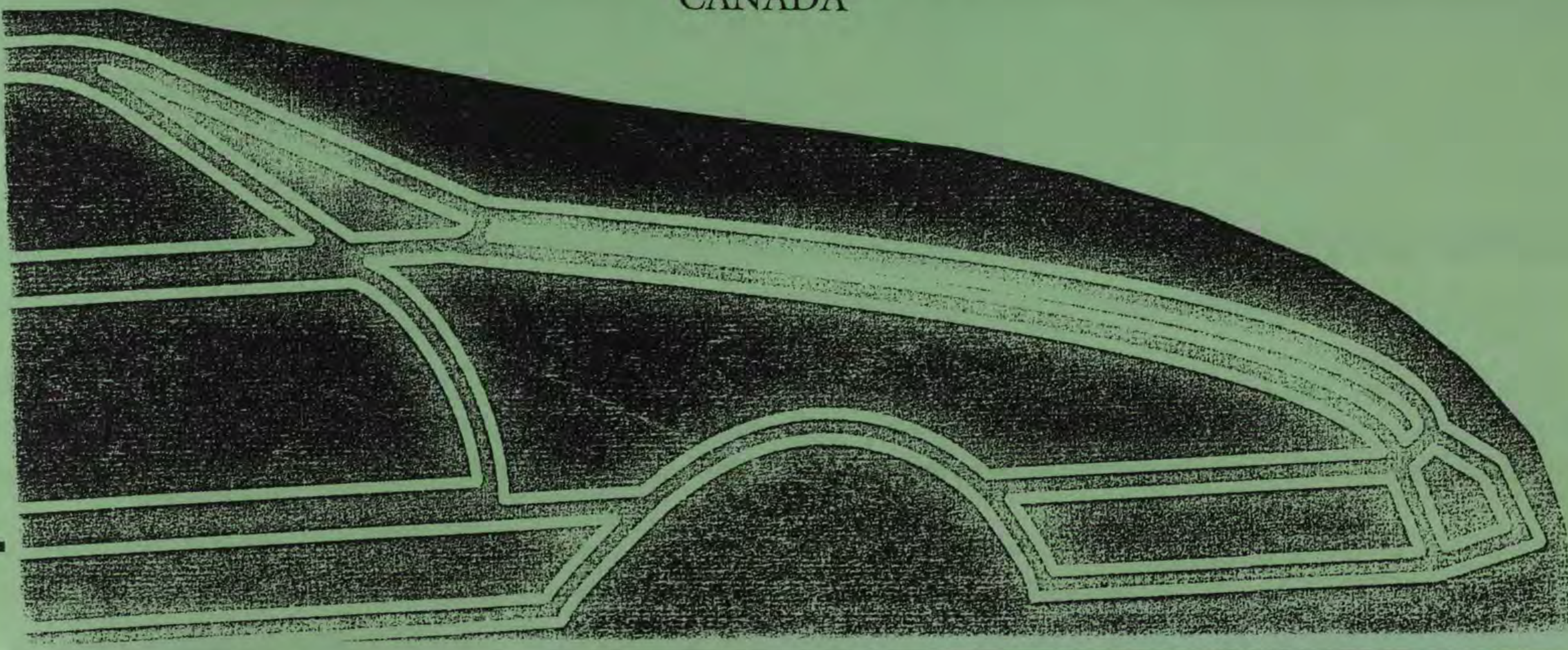
A.P.M.A.

ROUNDTABLE ON CLEAN CAR TECHNOLOGIES

SEPTEMBER 4, 1996

TORONTO, ONTARIO

CANADA



CANADIAN ROUNDTABLE ON CLEAN CAR TECHNOLOGIES
SEPTEMBER 4, 1996

In cooperation with the Automotive Parts Manufacturers' Association Board of Directors, the Automotive Branch of Industry Canada moderated this Roundtable on technologies involving the Program for a New Generation of Vehicles also referred to as the Clean Car.

Thanks to the Automotive Technology Team of Industry Canada for their contributions. For inquiries on this report please contact:

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Index of the Canadian Roundtable Proceedings:

EXECUTIVE SUMMARY: CANADIAN ROUNDTABLE ON CLEAN CAR TECHNOLOGIES:

In cooperation with the APMA Board of Directors, the Automotive Branch of Industry Canada moderated a Roundtable on Clean Car Technologies on September 4, 1996 in Toronto, Ontario. An excellent overview of the Program for a New Generation of Vehicles (PNGV or Clean Car) was presented by Mr. Rob Chapman, Chairman PNGV Task Force, U.S. Commerce, Washington D.C. and the potential for aluminium and advance materials was eloquently reviewed by Dr. Mike Wheeler, Director of Research for Alcan International, Kingston, Ontario.

The Clean Car is a research and development initiative with the North American Big Three (USCAR/CANCAR) and government looking into the challenges and opportunities to achieve an U.S. 85 mpg mid-size sedan by 2004 through technologies such as lightweight materials, fuel cells and reformers, flywheels, as well as new processes such as improved springback, intelligent resistence welding, aluminium die casting, high throughput hole making, dry machining, etc.,. Its Research Goals are:

1. *reduce design and manufacturing costs;*
2. *get near term advances in emission reductions;*
3. *and to develop a new class of vehicle to achieve up to three times the fuel efficiency of today's sedan (1994 models: Chev Lumina, Chrysler LH, Ford Taurus).*

The Alcan International session noted that the Clean Car provides a longer term framework with government labs and industry working toward common goals. With respect to materials, the Clean Car is to reduce weight by 40% while maintaining drive attributes. Alcan has participated in the Ford AIV, Chrysler Neon Lite, and the GM Impact programs. Other materials such as steel were also improving for the sector.

It was recognized that the parts suppliers and their positioning themselves re manufacturability of these new vehicle systems is a critical element. Mr. Pete Mateja, President of the Automotive Parts Manufacturers' Association, commented that this Roundtable was a good way to keep parts firms aware of the opportunities/threats and to stay abreast of such developments.

Also in attendance were the engineering Directors of the Canadian Big Three, Canadian niche technology players such as Agile Systems, ESTCO Energy, the National Research Council's Surface Transportation Center, and reps from Alcan Automotive Group. Industry Canada is seeking ways to increase the awareness of technology and the amount of automotive R&D in Canada and the resulting jobs and growth that may come from complimenting an initiative like the Clean Car. Information on this Roundtable is available from the: Automotive Branch, Industry Canada, 235 Queen Street, 10th floor, Ottawa, Ontario K2A 0H5 (FAX 613-952-8088).

A Presentation to the

Canadian Roundtable on Clean Car Technologies

on the

PNGV

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

by

Robert M. Chapman

Chairman, Government Technical Task Force

Department of Commerce

September 4, 1996

History

Bipartisan support for federal sponsorship of S&T

- Land Grant Act of 1862
- Agricultural Extension Service 1914
- Naval Research Lab established 1923
- WWII:
  - Manhattan Project
  - National Laboratories
  - Office of Naval Research

History (Continued)

- Post War - Five Great S&T Missions:

  1. Defense
  2. Basic Knowledge
  3. Health
  4. Space
  5. Energy and Environment

- Administration's focus on economic competitiveness:

  - S&T as an investment
  - Jobs, Jobs, Jobs!
  - Nourishment of generic, precompetitive technologies

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

Government Side of Partnership

Government Technical Task Force

- Eight Federal Departments and Agencies
- Lead: Department of Commerce
- Core program: Department of Energy, Transportation Technologies
- 18 National Laboratories
- Funding Level FY96: $293M

  1/3 Labs
  1/3 Suppliers
  1/3 OEMs (3/4 to Suppliers)

Genesis

Super Car/Clean Car

- Concept announced in President Clinton's February 22, 1993 "Technology for America's Economic Growth, A New Direction to Build Economic Strength"

PNGV

- Historic Government/Industry Partnership announced by President and CEOs of Big Three on 9/29/93
- Program structured as a model for future government/industry cooperation, seeks to avoid government mandates or dictation of market-related decisions

Why does the government have a partnership with the "Big Three" automakers?

PNGV
PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

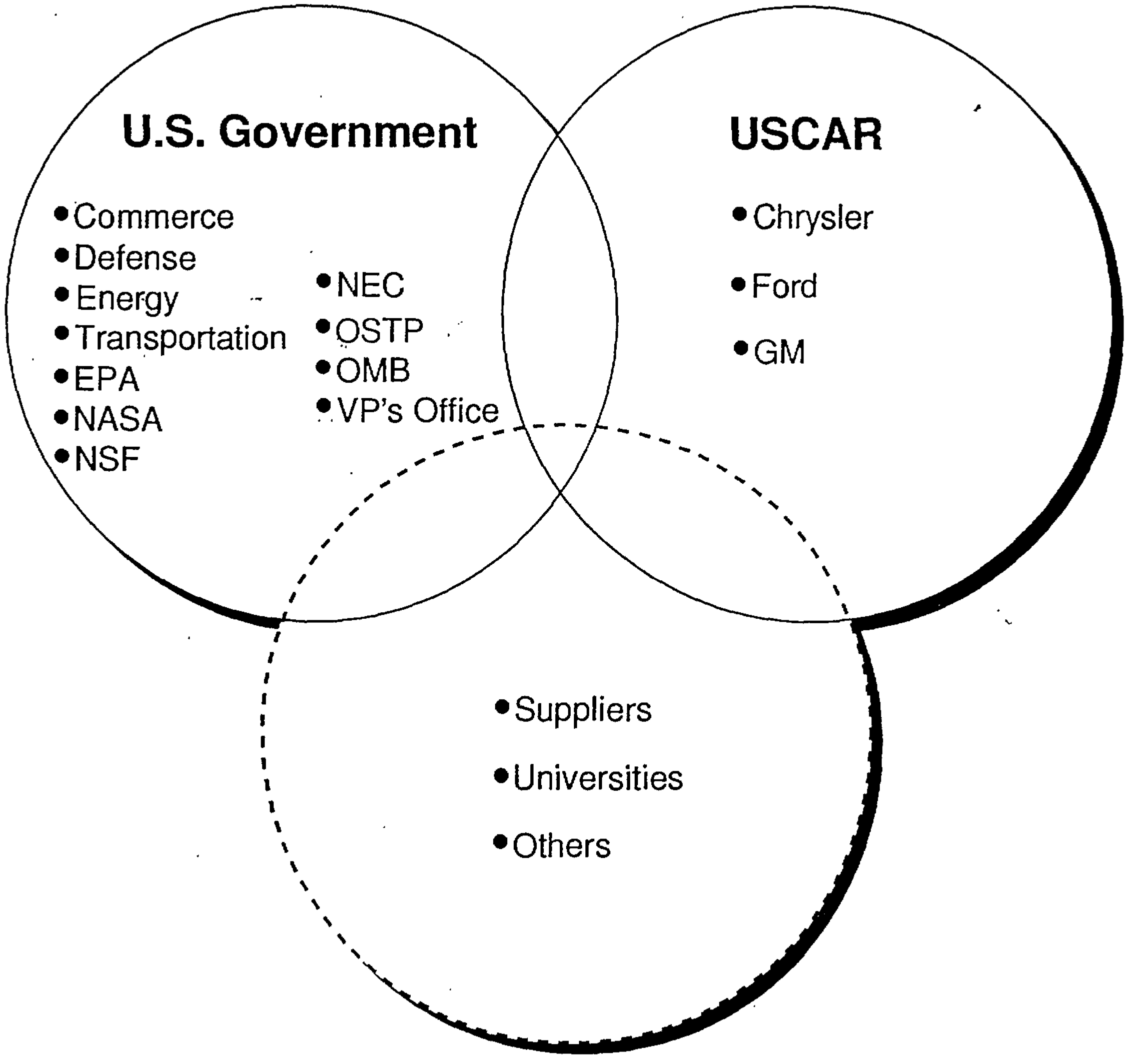
Technical
Task Force

- Ground transportation fuel makes up 43% of our petroleum-based energy supply
- Petroleum imports are 10% of our import inventory or 3/4 of the trade deficit
- Automobiles, trucks, and buses still contribute 33% of overall air pollution (VOCs and NOx)
- Automotive industry accounts for 1 out of 7 of all American jobs

The development of an energy efficient and low emission vehicle in an accelerated time frame is of great social value, but cannot be expected to be financed directly by car buyers

Partnership for a New Generation of Vehicles

Government Technical Task Force



PNGV
PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

Research Goals

Technical
Task Force

#1 Design & Manufacturing:

Reduce manufacturing production costs and product development times for all car and truck production

#2 Near-Term Improvements:

Pursue advances that increase fuel efficiency and reduce emissions of standard vehicles

#3 Long-Term: Next Generation Vehicle:

Within the next decade, develop a new class of vehicle with up to three times the fuel efficiency of today's comparable vehicle

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

Vehicle Parameters Summary For 3X Fuel Efficiency Goal

Technical Task Force

- Develop a class of vehicle with fuel efficiencies up to three times today's comparable vehicle, and:
  - Cost no more to own and drive than today's automobile;
  - Have range of at least 610 km (380 miles);
  - Maintain performance, size, utility; and
  - Meet or exceed safety and emission requirements
- Baseline vehicles are the Concorde, Taurus, and Lumina

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Broad Timetable

Technical
Task Force

Sept.

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005

Candidate Technologies

Low emission technologies
New materials
Advanced design simulations
Advanced batteries
Ultracapacitors and flywheels
Hybrid electrics
Turbines, 4SDI
Fuel cells, fuel reformers
Efficient air conditioning systems
Alternate fuels, compressed fluids
TBD

Narrow the Technology Focus

Concept Vehicles

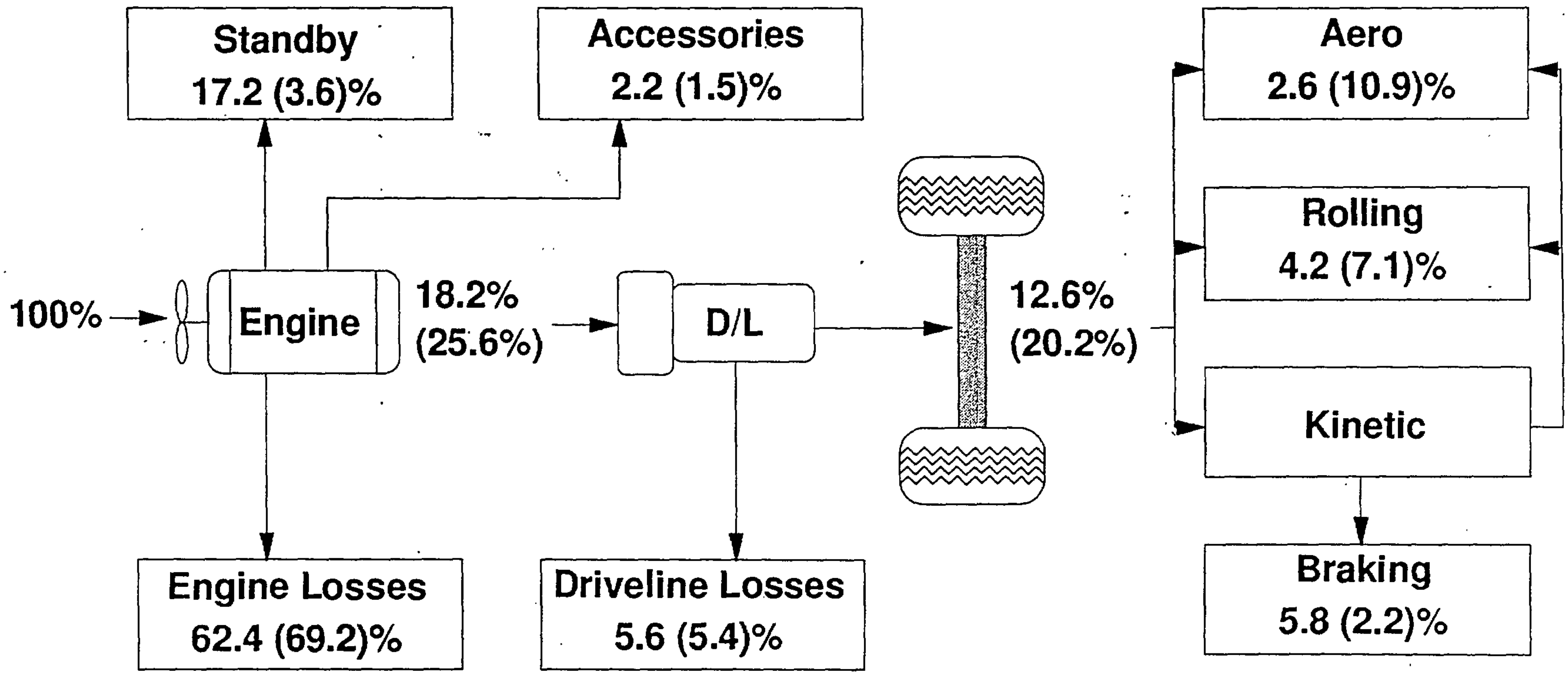
Production Prototype

//

Energy Distribution

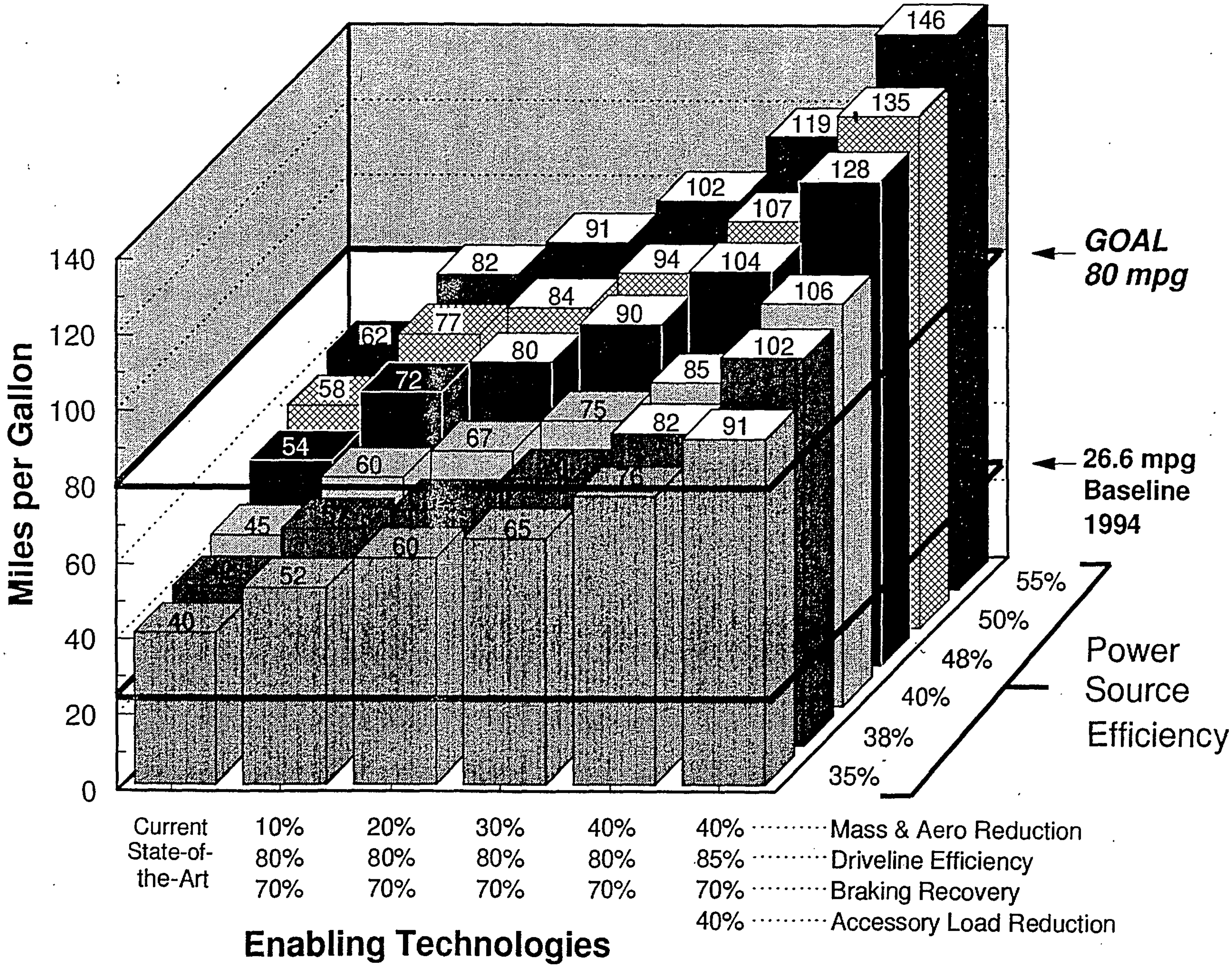
Technical
Task Force

Typical Mid-Size Vehicle



Urban (Highway)

Achieveable Fuel Economy for Proof-of-Concept Vehicles



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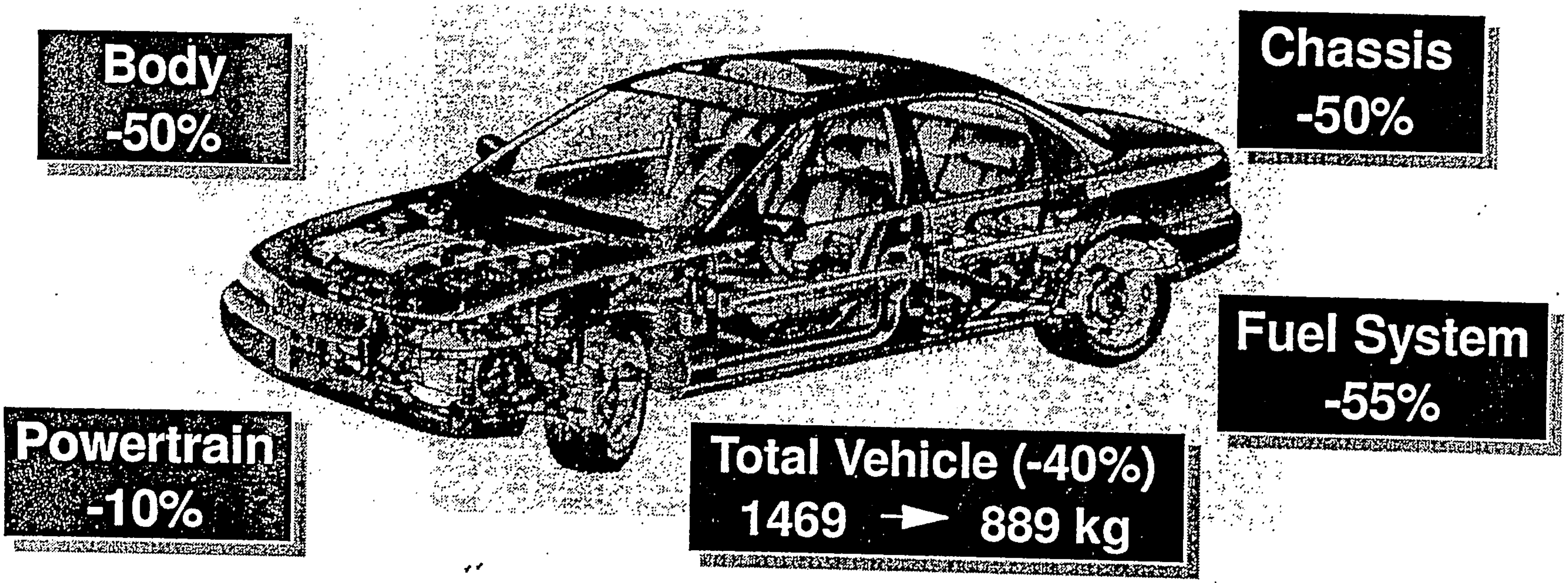
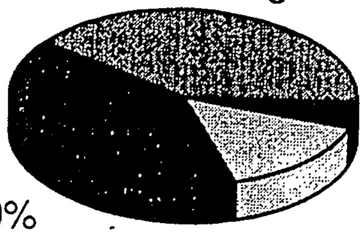
Materials Recommendations

Government
Technical
Task Force



- Focus on light metals and composites
- Deferred action on high strength steel, ceramics, and glass reinforced composites
- Confirmed R&D agenda of U.S. Automotive Materials Partnership (USAMP)



Budget Priorities

Changing Materials Usage

PNGV Materials
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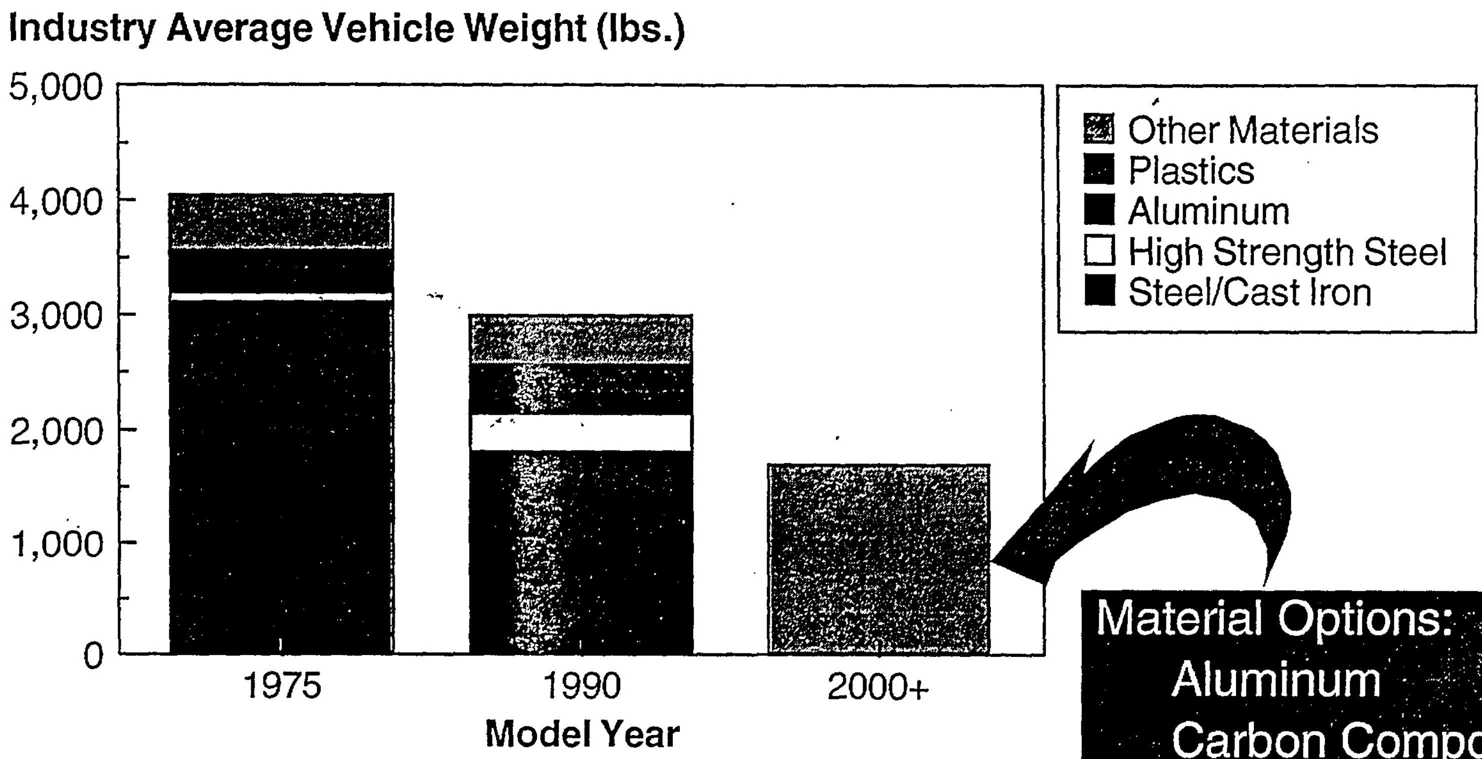


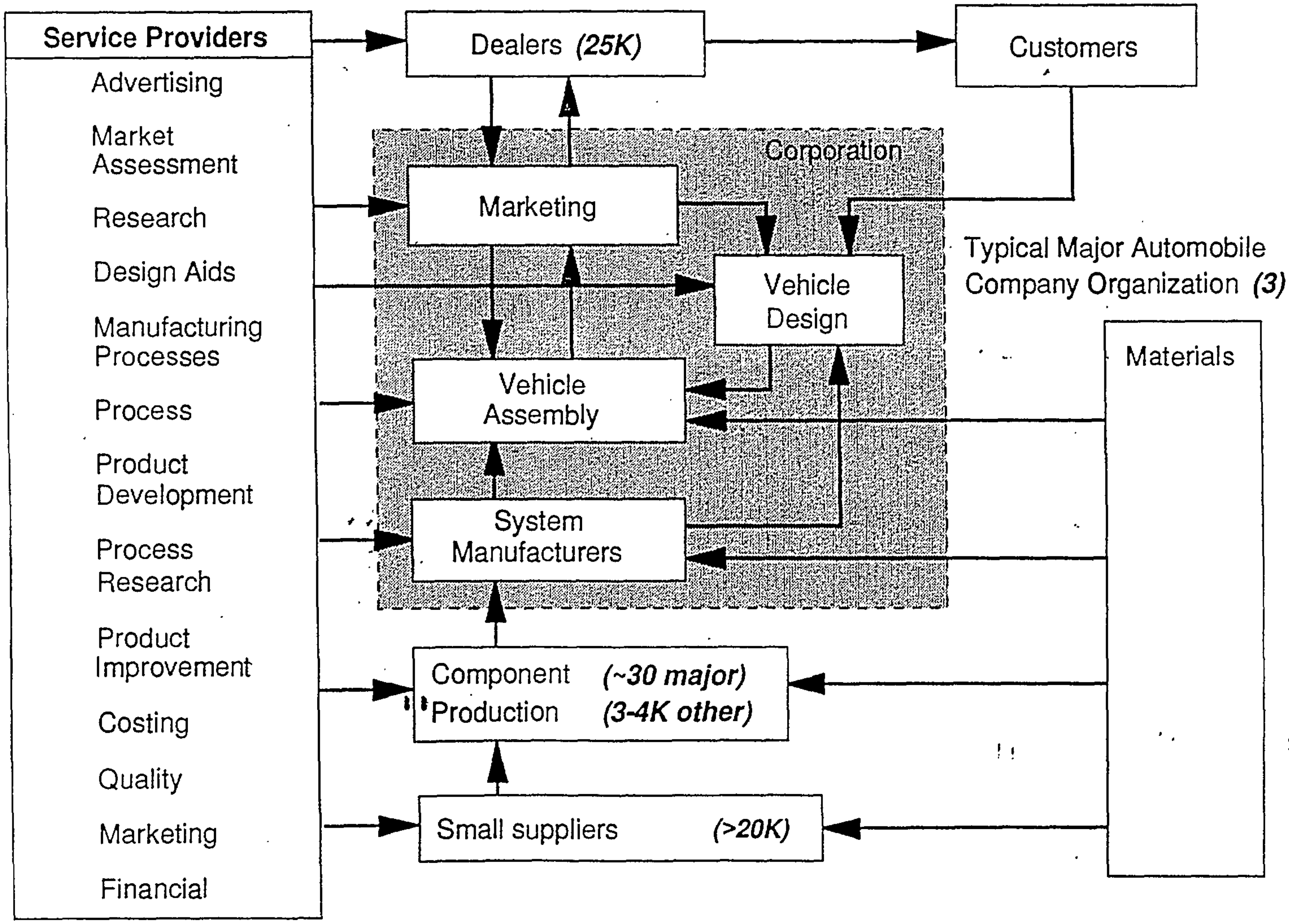
Material Options:
- Aluminum
- Carbon Composites
- Magnesium
- Steel

Major technical challenges are maintaining safety performance, recycling of composites, and achieving affordable cost.

Traditional Automobile Industry Structure

(# of firms)

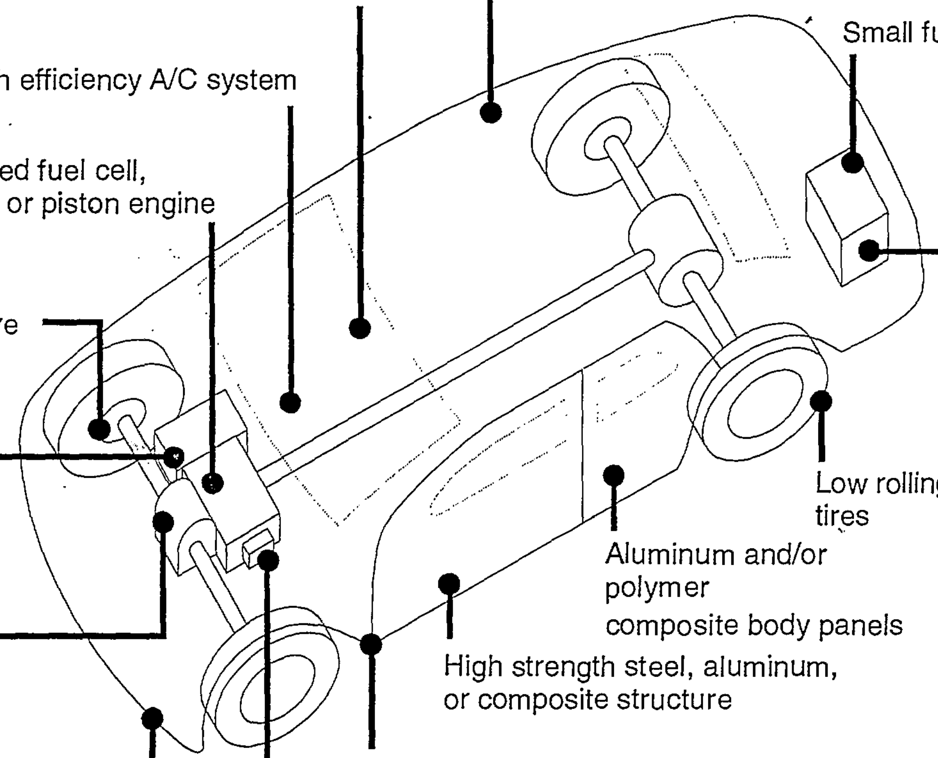
Government
Technical
Task Force



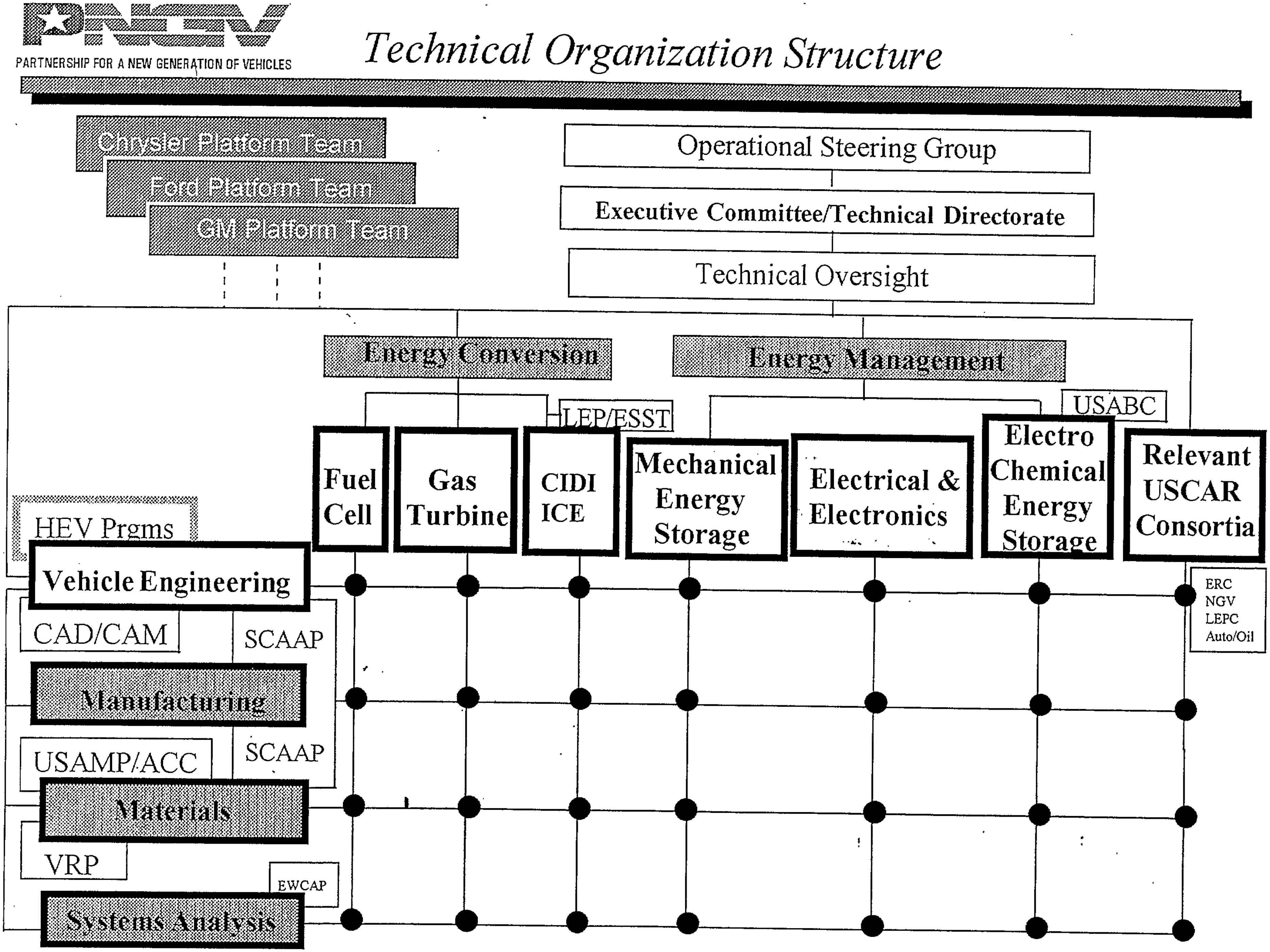
Source: A. Sobey, 1994

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

Preview of the Super Car



Technical Organization Structure



8/22/96

PARTNERSHIP FOR A NEW GENERATION OF VEHICLES

Summary

Government
Technical
Task Force

- PNGV is a unique, historic program with technical, environmental, economic, national security and social goals
- Objective: raise the level of automotive technology for a new class of vehicles through this partnership of government and industry
- Government is technology resource. USCAR prioritizes efforts and individual car companies will produce concept cars and production prototypes
- Canadian suppliers can have a role and may participate via Canadian government-sponsored cost-shared research
- The result should be more fuel-efficienct, environmentally acceptable automobile and an industry that, by incorporating advanced technology in their designs, is more competitive globally

THE OPPORTUNITIES AND CHALLENGES FOR ALUMINUM AND PARTS SUPPLIERS ARISING FROM THE PNGV PROGRAM

M.J. WHEELER
DIRECTOR OF RESEARCH - ALCAN INTERNATIONAL LTD.

Introduction

The PNGV program to develop mid-sized sedans which achieve 80 mpg (US) without compromising safety and performance and which will cost no more than similar sized conventional vehicles presents two major interlinked challenges. These are:

- *To reduce vehicle weight by 40% without increasing cost.*
- *To develop a lighter weight, higher thermal efficiency power train which costs little or no more than today's power trains.*

The targets for the weight savings are shown in the next slide and, as you can see, represent a significant challenge, especially as costs cannot be increased to achieve the weight saving. Nevertheless, weight saving begets weight saving and, of course, with less dense materials, higher costs/lb can be accepted. Today, I want to concentrate mainly on vehicle bodies and more specifically on the technologies that have been developed by the aluminum industry for the manufacture of light weight bodies and I will be drawing upon two previous PNGV presentations, the first one made last October, for the National Research Council's peer review of the PNGV program and the second the briefing given to the press at the Oak Ridge National Laboratory this May.

The body structure of a vehicle is really the determining factor in the total weight of the vehicle and this is especially so in the PNGV program where failure to reach down to the body weight of 500 lb (250 kg) would mean that a more powerful and hence heavier power train would be required. In turn, this would require the chassis components to be upgraded and this might mean that the body structure would then have to be strengthened to carry the added weight of the power train and chassis. This, of course, is the exact opposite of weight saving begetting weight saving.

Aluminum, steel, composite materials and even a high strength stainless steel are all candidate materials for the body structure, but, in reality, aluminum is the only material where the weight reduction target has been all but met today in road going vehicles. Further, the materials used are available today in high volume and the body structure manufacturing technology was developed essentially for high volume production. Thus the front runner at the moment is a stamped and weld bonded sheet aluminum unibody structure and I will describe this in some detail because it could be key to the opportunities and challenges that will face the Canadian parts manufacturers in becoming involved in the PNGV program and in the eventual production of PNGV-based cars.

Vehicle Body Structures and Closure Panels

(a) ***Opportunities***

Weight savings of almost 50% have already been successfully demonstrated with aluminum unibody structures in the Ford AIV, the GM EV_1 and in Chrysler's Neon Lite, the first two of these employing Alcan's

AVT structural bonding system. The Ford AIV body structure is a good example providing, as well, high torsional rigidity and at least equal crashworthiness to the regular Ford DN5 Taurus. It now appears that aluminum designs can be developed to achieve almost 55% weight saving and this is possible using essentially the same materials and assembly technology that have been successfully proven through the AIV and EV_1 programs. In fact, two PNGV concept cars, Ford's Synergy 2010 and Chrysler's Intrepid ESX have been designed based on aluminum unibody structure.

By comparison, the ultralight steel autobody structure study indicates that only some 24% weight saving (146lb or 66kg) could be achieved in comparison with the DN5 Ford Taurus. While engine and chassis down weighting would allow some more weight to be taken out of the body structure, steel would still be a long way from meeting the PNGV weight target.

The vehicle body also includes the closure panels and the weight chart for the Ford AIV shows that here too aluminum sheet enables very significant weight savings to be made. In fact, some nine volume production vehicles already have one or more aluminum closure panels and more are slated for introduction. Aluminum closures can be found on the all new 1996 Ford Taurus/Mercury Sable models, the 1996 Ford F-150 truck, the 1997 Lincoln Mark VIII and on the GM Aurora/Riviera models. What make these attractive, even in today's vehicles, is the 50 to 55% weight saving that is achieved with the heat-treatable 6000 series aluminum alloys which harden during the vehicle paint baking to give a high yield strength and hence excellent dent resistance.

Closure panels are the most challenging panels to produce and yet some are being produced at the rate of 400 units/hours - a high rate even for steel closure panels. And by the end of this year, the annual rate of production for aluminum closure panels will be about 1.7 million.

(b) The Challenges

While aluminum may seem to be the material of choice for PNGV vehicle bodies, there are still a number of significant obstacles to overcome, not least of which is the cost of aluminum and the costs of part manufacturing and assembly, some perceived and some very real which have to be addressed by the material suppliers, by the parts and subcomponent suppliers, by equipment suppliers and by the car companies themselves for aluminum to become the chosen material.

Many of these issues were addressed in a PNGV workshop last September where the following list of challenges were identified. Some of these are now the subject of joint programs involving variously material suppliers, some of the US National labs, parts suppliers and the car companies themselves.

- *Cost of aluminum sheet.*
- *Alternative forming methods to obtain enhanced shape capability.*
- *Springback reduction and/or control.*
- *Modelling techniques to optimize the forming process and tooling configuration.*
- *Improved knowledge on joining methods including improved process understanding and control for spot welding.*
- *Improved recycling methods including full metal recovery and alloy separation.*

The aluminum industry now fully understands the need for cost reduction, but it will be up to the initiative of individual producers to respond. However, production costs will clearly fall as demand increases through process optimization and through the more efficient scheduling and product grouping that come through the economies of scale.

As the need to invest in new production facilities arises, further cost reduction should be possible through the development of integrated continuous casting/sheet rolling. Such processes eliminate much of the rolling reduction necessary with the conventional large ingot/hot mill process route.

Other process savings may also be possible, eg. a less costly finishing system for body structures as a result of adopting aluminum but this will require and, indeed, presents, for example, an opportunity for the pretreatment and paint companies to become actively involved in the PNGV program,. The next slide shows a potential new system for finishing aluminum bodies.

The successful development of a manufacturing system for making aluminum tailor welded blanks would also reduce the costs for using aluminum. This is already an established practice for steel and reduces stamping offal and the number of tool sets required, improves part structural integrity and eliminates the part stack-up variations that result from joining two or more stampings together.

Some other initiatives, some of which address both aluminum and steel issues are:-

- *The Intelligent Resistance Welding Program at the University of Michigan.*
- *The Fraunhofer Institute's Aluminum Laser Welding Program.*
- *The Springback Predictability Project at the Oak Ridge National Laboratory.*
- *An Aluminum Association Program to predict the future mix of aluminum alloys available for recycling arising from scrapped automobiles and also a projected program to develop an alloy sorting technology for scrap.*

Other Body Structure Applications

While the body structure and closure panels make up most of the body weight, weight saving must also be achieved in all the other body components, eg. the glazing, seats, the instrument panel beam, internal trim, the steering column, the foot pedals and various support assemblies where there will be opportunities for cast magnesium and composite material components, and especially where part and function integration can be applied to save cost as well as weight.

Chassis

Even through the weight of the body structure will determine the performance required and hence the weight of the power train and the chassis, the PNGV mass reduction goals also call for a 50% weight reduction in the chassis.

Clearly, aluminum is already being used for a number of chassis components especially wheels and could have many more applications if cost/quality/structural performance issues can be resolved. This was again the subject of a PNGV/Workshop in Detroit in May of this year. There are obviously opportunities for castings (and there are several new processes such as squeeze casting, semi solid casting/forging being developed), extrusions, stampings and forgings as well as for metal matrix materials if the costs of those materials can be justified by the weight saving.

Some key needs identified in this workshop were:-

- *A reduction in the number of casting alloy types specified by the car companies.*
- *Inexpensive and user friendly techniques for monitoring molten metal quality and gas content so that tedious and expensive product testing can be eliminated, i.e. achieving product quality by process monitoring and control not by testing.*
- *Closer and up front cooperation on part design and material choice so that the attributes of individual processes can be exploited in the part design to maximize structural performance hence to minimize both weight and cost.*
- *The development of near net shape processes to minimize processing costs and scrap generation.*

Unlike the body structure challenge where perhaps only one or two solutions will emerge, there will be many different solutions for chassis components and here it will be important for individual component manufacturers to optimize their processes and to develop strong and, if possible, direct liaison with the car companies. It will also be important to have good contacts with the major metal suppliers who often have technology available to assist component manufacturers such as finite element modelling of parts to determine high stress locations or for the modelling of die cavity filling and the mold chilling conditions to minimize dendrite arm spacing and hence to maximize strength in high stress locations. The major producers can also provide technology and advise on metal quality improvement to minimize scrap production.

There is a project at the Oak Ridge National lab with a novel squeeze casting project with Thompson Aluminum Casting Co. and there is also a PNGV project on Design and Product Optimization for Casting Light Weight Metals with several of the US National labs, Georgia Tech. and USAMP. This is addressing issues such as:-

- *Effect of process and component design on microstructure.*
- *Relationship between microstructure and properties.*
- *Development and lower cost alloys.*

Some other relevant projects already underway are:-

- *Rapid Tooling for Functional Prototyping of Metal Mold Processes.*
- *Laser Welding of Aluminum.*
- *Process Control for Laser Beam Welding.*
- *Spray Formed Tooling for Automotive Components for Prototype and Production Molds.*

The results of these programs may not be available to Canadian producers, but they do illustrate the effort being put into these programs in the US. The existence of these programs also indicates that Canadian parts manufacturers should perhaps be working together to identify common goals and, if possible, to obtain support funds from the federal and/or provincial governments to help those manufacturers to be at the forefront of the opportunities arising from the PNGV program.

Survey and Recommendations

I hope that given you some insight into the opportunities and challenges presented by the PNGV program. However, I have not mentioned power train developments at all where entirely new approaches such as hybrid internal combustion/electric drive systems or even fuel cell/electric drive systems are possibilities, thereby creating opportunities for a wide variety of new materials and technologies. There is, for instance, the hydrogen-powered fuel cell development of Vancouver-based Ballard Power Systems which GM is using one of its fuel cell development. However, such developments are generally considered to be too far away for the current PNGV timetable. Also, I have essentially ignored steel and composite materials because I am not actively working with these materials but, clearly, there are clearly opportunities for the innovative use of both these materials in the PNGV program.

However, the main message I would like to leave you with is that the PNGV program is providing a major opportunity for aluminum in a whole variety of product forms and I would like to end here with the following conclusions and recommendations.

- *The car companies can meet the PNGV targets of weight reduction, manufacturing feasibility and product performance with aluminum sheet and this is emerging as the material of choice for body structures and closure panels. However, material and manufacturing costs are still issues to be resolved.*
- *Aluminum in the form of stampings, extrusions, castings and forging will be in demand for chassis components in PNGV vehicles.*

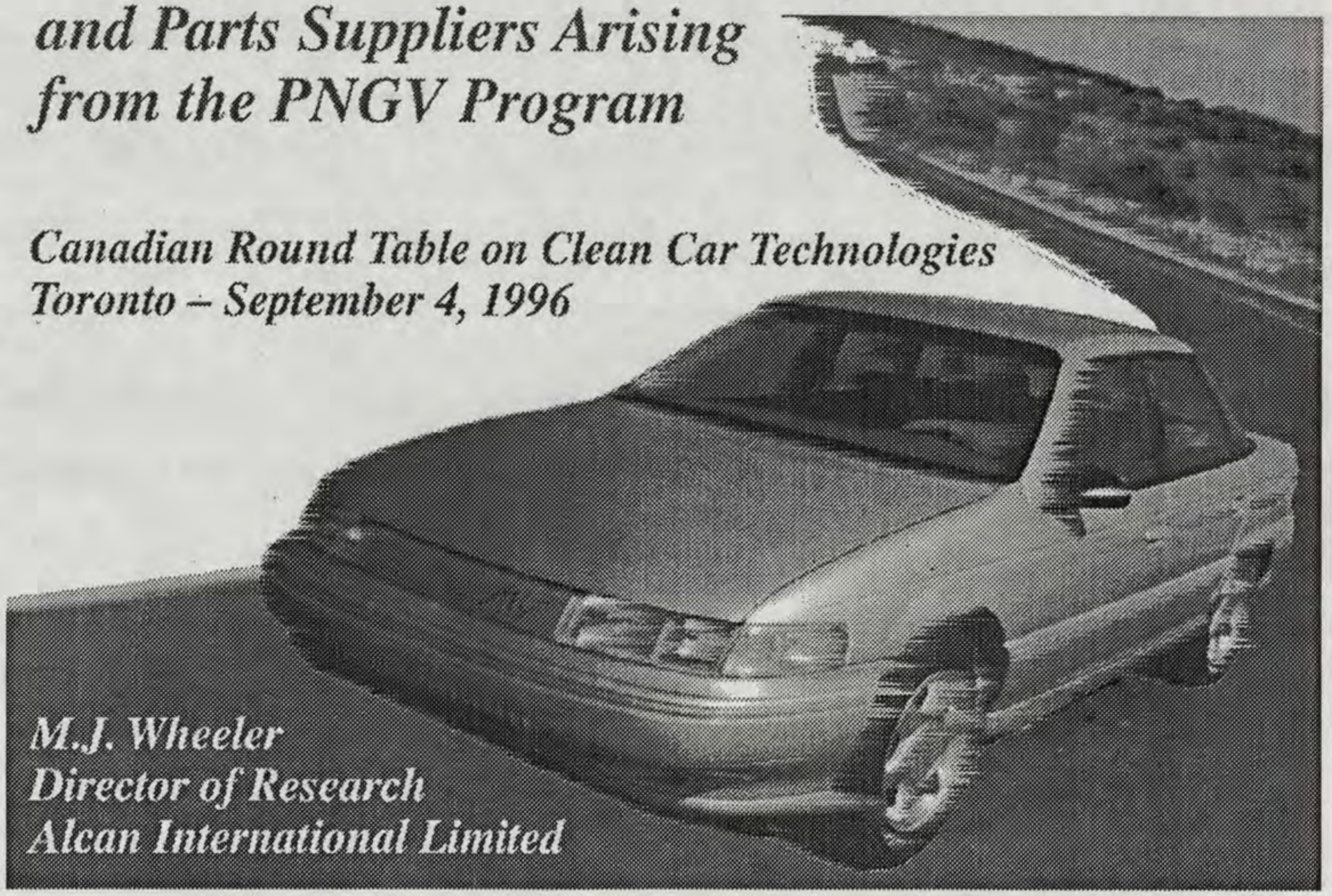
- *PNGV concept cars are not being designed and it is important to establish interfaces with the car company PNGV teams to identify product opportunities and to preserve business which otherwise would be lost as material and produce specifications change. This applies to all materials and product forms.*

- *The opportunities for joint research/development programs should be explored by the Canadian automotive parts manufacturers since they may be at a competitive disadvantage with their US counterparts who will have the benefits of US government-sponsored PNGV focused research programs.*

Thank you for your attention.

The Opportunities and Challenges for Aluminum and Parts Suppliers Arising from the PNGV Program

Canadian Round Table on Clean Car Technologies
Toronto – September 4, 1996



M.J. Wheeler
Director of Research
Alcan International Limited

PNGV

The PNGV Challenges

- **To reduce the the weight of mid-sized sedans by 40% without increasing cost**
- **To develop lighter, higher thermal efficiency power trains**

PNGV Vehicle Mass Reduction Goals for 3X Fuel Economy Gains

System	Current Vehicle (lb)	Target (lb)	Decrease (%)
Body	1134	566 *	50
Chassis	1101	550	50
Powertrain	868	781	10
Fuel/Other	137	63	55
Curb Weight	3240	1960	40

******Major items are the Body-in-White and closure panels, but also includes:***

- Glazing
- Seats
- Dashboard assembly
- All other internal fittings

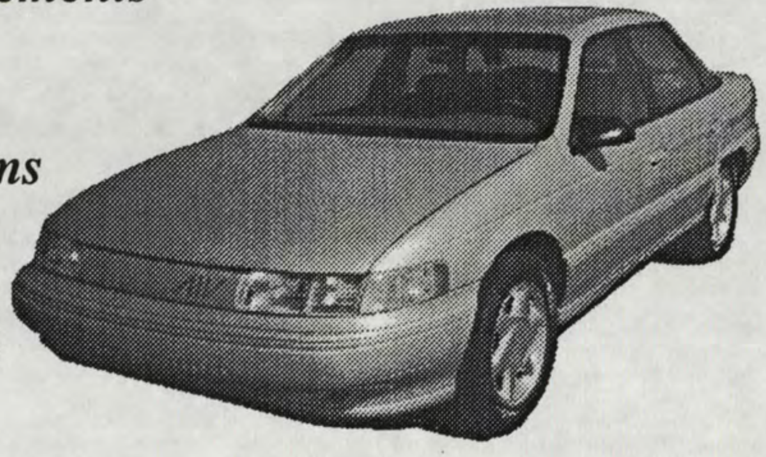
Why the PNGV Goal is Achievable

"Weight saving begets weight saving."

...unfortunately, the opposite is also true.

Outline

- **Aluminum for Body Structures and Closure Panels**
  - ***- Opportunities and achievements***
  - ***- Challenges***
  - ***- Some established programs***



- **Chassis Components**
  - ***- Parts suppliers' concerns***
  - ***- Established programs***
- **Summary**

Vehicle Body Structures and Closure Panels

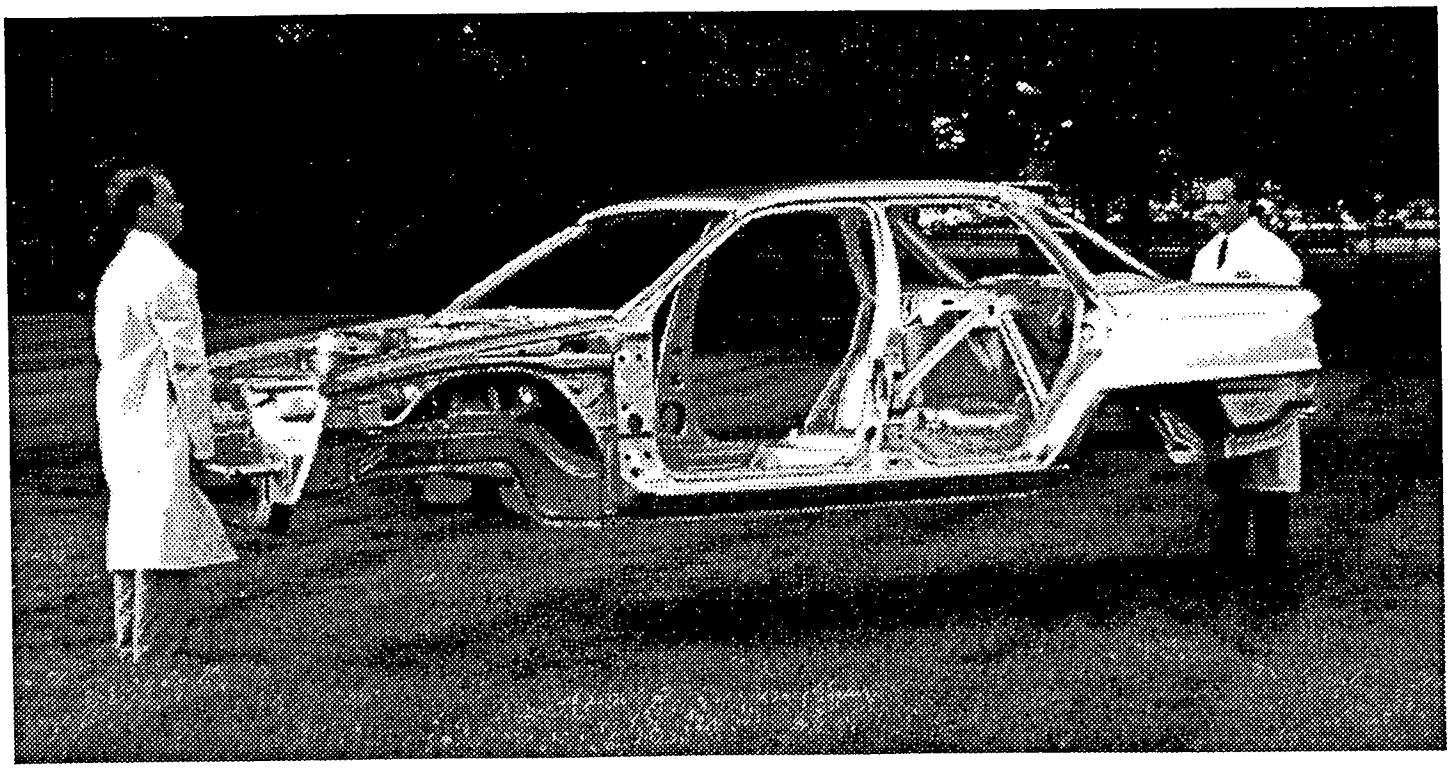
Ford AIV

Plymouth Neon Lite

GM Impact

PNGV

Body-in-White Structure of the Ford AIV (320 lb)

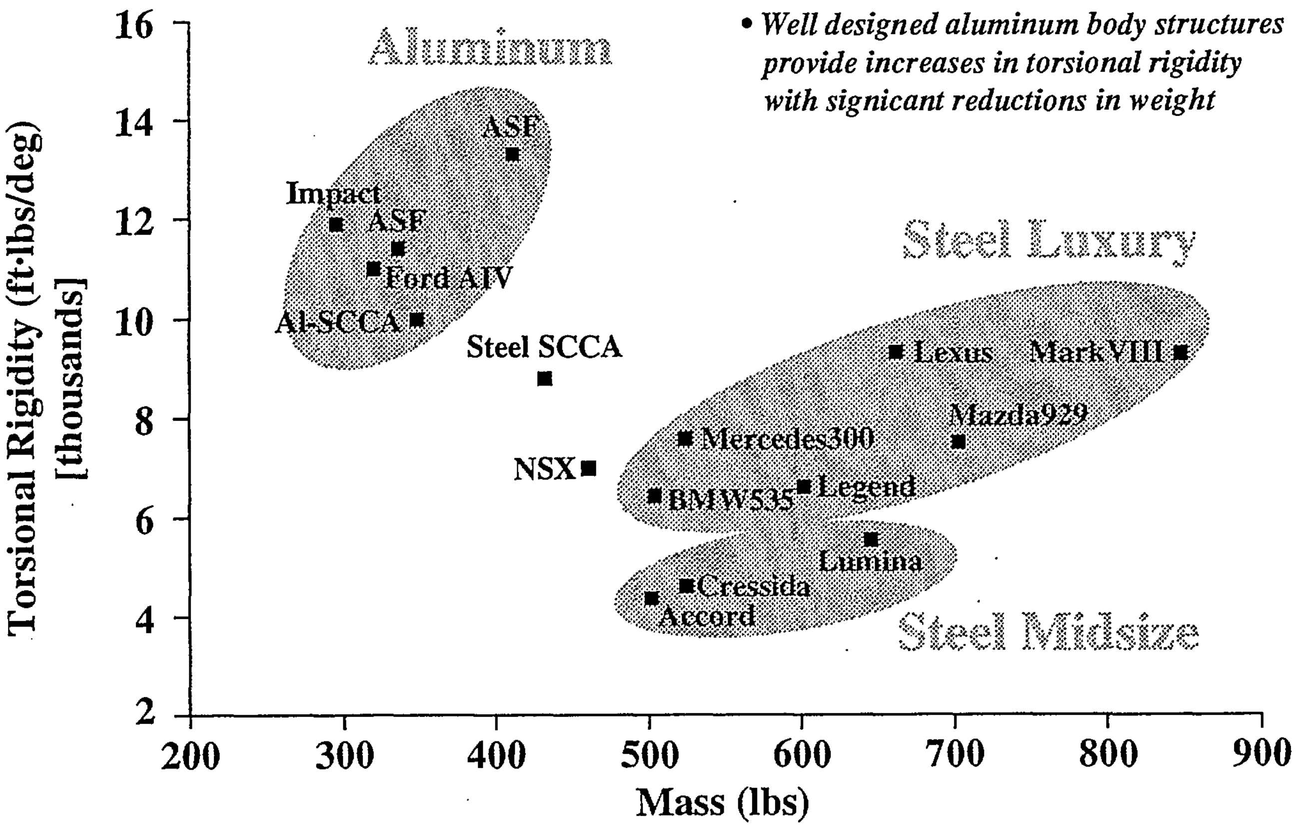


Weight Savings in Ford AIV

	lb			
	Steel	Al	Wt Saved	% Saved
Body structure	596	320	276	47
Hood, deck and fenders	90	38	52	58
Front and rear doors	132	79	53	40
Total body and closures	818	437	381	47
Total vehicle	3275	2894	381	12

Based on published Ford information

Torsional Rigidity vs BIW Mass (unglazed)



- *Well designed aluminum body structures provide increases in torsional rigidity with signicant reductions in weight*

Frontal Barrier Crash Results for Ford DN5 Steel and AIV Vehicles

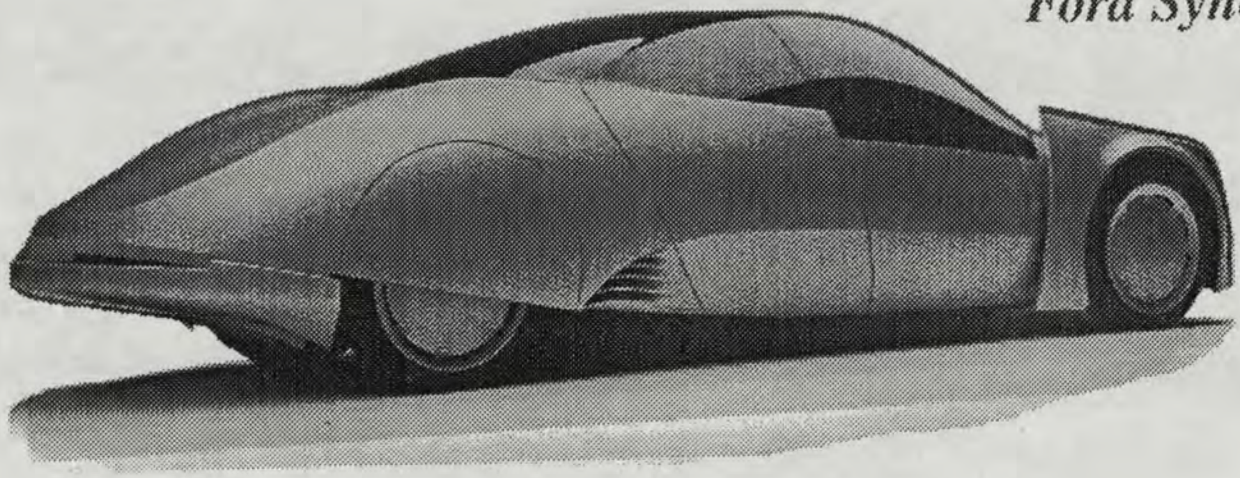
(Driver side safety belt and airbag†)

	AIV	Steel	NHTSA Req.
Dynamic Crush (in)	30.8	28.4	—
Head Injury Criteria	549	524	1000
Chest Acceleration (g)	37	53	60
Chest Displacement (in)	1.4	1.4	3.0
Torso Belt Load (lb)	1219	1686	—
Left Femur (lb)	697	1644	2250
Right Femur (lb)	906	1092	2250

†Provided by the Ford Motor Co., Dearborn MI

PNGV Concept Cars

Ford Synergy 2010



Dodge Intrepid ESX

PNGV

Experience Through Production of Aluminum Closures

Ford F-150

Ford Crown Victoria

Mercury Sable

Buick Riviera

Current and Future Closure Panels

Lincoln Town Car	Hood
Mercury Marquis	Hood and deck lid
Ford Crown Victoria	Hood and deck lid
1996 Ford Taurus	Deck lid
1996 Mercury Sable	Deck lid
Oldsmobile Aurora	Hood
Buick Riviera	Hood
1996 Ford F-150 Pickup	Hood
1997 GM AVP Minivans	Hoods
1997 Lincoln Mark VIII	Hood
1997 Buick Park Avenue	Hood

Progress Toward PNGV Objectives

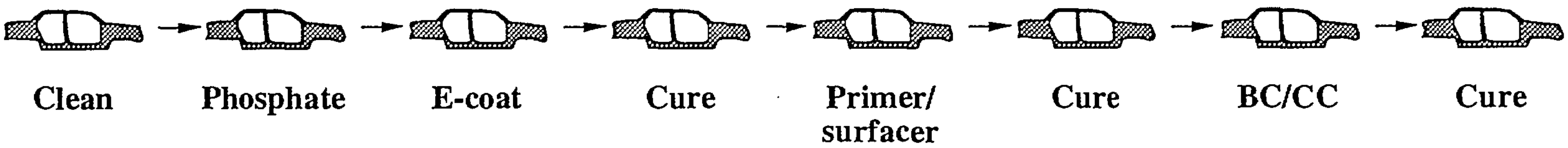
- **Aluminum unibody-based designs can save more than 50% of current structure weight**
- **Technology and materials proven through Ford AIV and GM *Impact* programs**
- **Aluminum weight savings maximizing secondary weight and cost savings**
- **Development of manufacturing and assembly processes to achieve high-volume affordability**

Some Identified PNGV Challenges for Aluminum in Vehicle Bodies

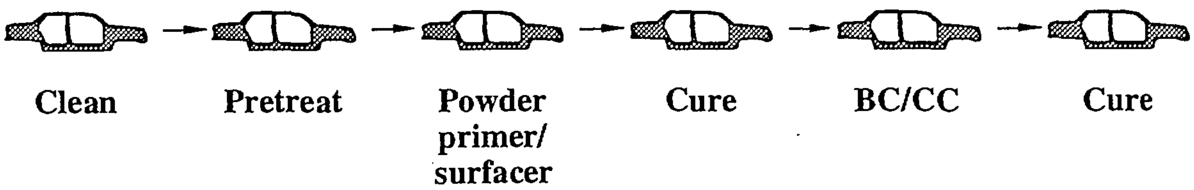
- Cost of material
- New forming methods for enhanced shape capability
- Springback prediction and reduction
- Improved knowledge and process control for spot welding
- Technology for closed loop recycling

Conventional vs Alternative Finishing Systems

Today



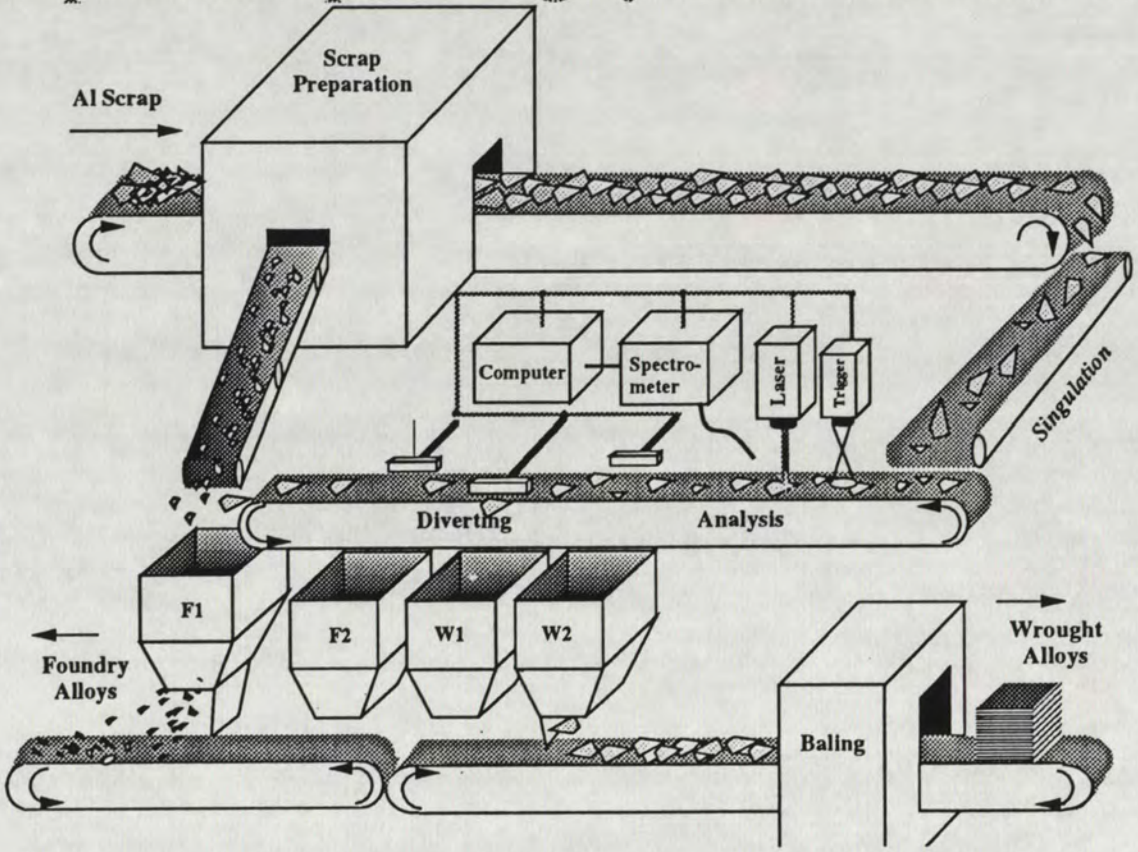
Tomorrow?



Some Current PNGV Related Programs

- *Intelligent Resistance Welding Program* at the University of Michigan
- Fraunhofer Institute Aluminum Laser Welding Program
- *Springback Predictability Project* at ORNL
- Aluminum Association programs on future scrap mix prediction and scrap alloy sorting

Concept of Scrap Sorting by Laser-Induced OES



PNGV

Chassis Components

Parts Suppliers' Concerns

- Reduction in alloy types in car company specifications
- Methods for checking molten metal quality to reduce/eliminate need for product certification
- Up-front cooperation on part design, material and process choice
- Development of near net shape processes

Chassis Components

Established Programs

- ORNL/Thompson Aluminum Squeeze Casting
- Design and product optimization for casting lightweight metals
- Rapid tooling for functional prototyping of metal mold processes
- Laser welding of aluminum
- Process control for laser beam welding
- Spray formed tooling for automobile components for prototype and production molds

Summary and Conclusions

- The car companies can achieve the PNGV body weight targets, manufacturing feasibility and product performance with aluminum sheet, and this is emerging as *the* material of choice for body structures and closure panels—however, material and manufacturing costs are still issues to be resolved
- Aluminum in the form of stampings, extrusions, castings and forgings will be in demand for chassis components in PNGV vehicles

Summary and Conclusions

- Concept cars are now being designed, and it is important to establish interfaces with the car companies' PNGV teams to identify product opportunities and to preserve business which would otherwise be lost as material and product specifications change. This applies to all materials and product forms.

Summary and Conclusions

- The opportunities for joint research development programs should be explored by the Canadian automotive parts manufacturers, since they may be at a competitive disadvantage with their US counterparts who will have the benefit of US government sponsored, PNGV focused research programs.

U.S. Clean Car Big Ten (random order) Process Tech List (September 1996)

1. Springback Improved Predictability: Aimed to develop and validate a 3-D computer code to accurately predict stress, strain, fracture and geometrical imperfections in sheet metal draw, restrike and flanging dies, with emphasis on springback effect after removal from the die, using an incremental theory of elasto-plasticity.

2. Intelligent Resistence Welding: Intended to improve the quality and consistency of resistence spot wlding. A new multi variate approach to process monitoring and control will be developed and implemented. May reduce up to 30% of welding spots in automobile bodies.

3. Ergonomics for Hand Tools: Develop new torque tools and process that give accurate clamping loads, but do not create ergonomic injuries. Include automated torque monitoring networks with closed loop feedback and adjusting mechanisms.

4. Increased Paint Efficiency: Develop, evaluate and validate painting technology materials, equipment, facilities, and processes which may improve product appearance and durability while reducing/eliminating solvent emissions.

5. Featured Based Modeling: Activity includes development of standard entities (features) as set of data across different CAD systems/platforms. This will allow reduction of manufacturing and design complexity and costs.

6. Aluminium Laser Welding: Fundamental joining process for aluminium (which will allow mass reduction of up to 50%). Tailor welded blanks using this method.

7. Component Leak Testing: To find the right technology to identify leaks, indicate the leak location, and to qualify th eleak rate simultaneously for high volume production. This will allow to improve environmental performance, efficiency, and competitiveness of U.S. vehicles.

8. High Throughput Hole Making: As part of implementation of flexible manufacturing systems, high speed tooling is required. The benefits that will be attained include higher productivity and cost reduction.

9. Aluminium Die Casting: To improve the quality and economics of die casting of aluminium tooling cost needs to be reduced as well as defective part production. Surface porosity should be overcome and the increse on the life of die steels must be achieved. A substantial increase on speed of implementation of die casting processes is expected.

10. Dry Machining of Aluminium: Develop enabling technologies to achieve the machining of aluminium components without using metal cutting coolant. This will reduce capital cost, anticipate future safety and environmental regulations, and simplify the factory floor which will translate into more agility.

The Automotive Parts Manufacturers' Association

APMA is the national association representing OEM producers of parts, equipment, tools, supplies, and services for the worldwide automotive industry.

The Association was founded in 1952 and has 400 members which account for 90 percent of the independent parts production in Canada. 1994 automotive parts sales were $19.4 billion and the idnustry employed 82,000. Projected sales for 1995 are $22 billion and employment 84,000.

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Fact Sheet

TECHNOLOGY PARTNERSHIPS CANADA

"A Team Canada Approach to Technology Development"

What is the purpose of Technology Partnerships Canada (TPC)?

TPC is designed to enhance wealth creation by making Canadian firms more innovative.

What does it do?

In partnership with the private sector, TPC invests in research, development, demonstration, and market development of:

- environmental technologies, including: pollution prevention and protection, water treatment, recycling technologies, and clean car technologies;
- enabling technologies, such as advanced manufacturing technologies; advanced materials, biotechnology, and selected information technologies;
- aerospace and defence industries, including avionics, flight simulators, aircraft communications, satellite remote sensing and surveillance, security systems, and defence conversion.

Together, these high technology sectors had estimated sales of $47 billion and employed almost 300,000 Canadians in 1994. These are the sectors of the new economy that will generate the jobs and growth Canada needs.

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Canadian Roundtable on Clean