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A Vehicle for Change
PNGV, An Experiment in Government-Industry Cooperation

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This document was submitted as a dissertation in December 2009 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of James Bonomo (Chair), Steven W. Popper, and Paul C. Light.
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This research assesses the effectiveness of the Partnership for a New Generation of Vehicles (PNGV) in improving relationships among its members. The period examined is the decade of the 1990s, a period when U.S. industrial competitiveness was a significant national concern, and laws enabled new forms of industrial cooperation such as R&D partnerships. While PNGV’s ultimate technical accomplishments were limited, this study finds that this government-industry partnership did improve the relationship between the government and this industry. This study also provides practical observations on specific aspects of a partnership to emulate or avoid. This research should be of interest to those in government, industry, or academia studying public-private R&D organizations, including individuals seeking to create or improve a government-industry R&D partnership.

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ABSTRACT

The Partnership for a New Generation of Vehicles (PNGV) was established in 1993 by the Clinton Administration to improve national competitiveness in manufacturing, advance automobile technologies to improve fuel efficiency, and implement innovations from ongoing research into conventional vehicles. PNGV pursued these goals as a research and development (R&D) partnership, joining the efforts of the federal agencies with the Big Three domestic automobile manufacturers (Ford, GM, and Chrysler). Underlying the stated technical goals for the partnership was a more fundamental goal: to improve the relationship between the federal government and the U.S. auto industry.

This dissertation provides a detailed, multi-source case study to assess: (a) the effect of PNGV on the relationship between government and the U.S. automotive industry, and (b) the effect of PNGV on cooperation within the automotive industry. The dissertation builds upon a wide variety of data sources compiled over 15 years, including program documents, articles, studies, and original interviews with PNGV participants and observers.

This dissertation finds that PNGV was a significant factor in improving the relationship between the government and the Big Three. Many articles, reports, and original interviews note improvements in the government-industry relationship during the 1990s, and many of those specifically attribute these improvements to PNGV. The dissertation also finds specific ways in which the cooperation among the Big Three improved, but it is unable to conclusively attribute these improvements to PNGV.
Additionally, this study indicates some support for two other effects of PNGV. First, PNGV may have had some positive side effects in its marketplace by sparking the interest of non-PNGV participants in developing alternative automotive technologies. This in turn may further have promoted domestic interest in these technologies. Second, many articles and interviewees suggest PNGV’s possible role as a model for R&D cooperation beyond the context of the automotive industry. Indeed, some subsequent government-industry efforts overtly borrowed from PNGV’s organizational approach.

Ultimately PNGV failed to achieve its technical goals. Regardless, the PNGV case provides encouragement for future efforts in pursuing collaborative approaches, as well as practical observations on aspects of a partnership to emulate or avoid.
SUMMARY

The Partnership for a New Generation of Vehicles (PNGV) was established in 1993 by the Clinton Administration to improve national competitiveness in manufacturing, advance automobile technologies to improve fuel efficiency dramatically, and implement innovations from ongoing research into conventional vehicles. To pursue these goals, PNGV was created as a research and development (R&D) partnership, joining the efforts of federal agencies with the Big Three domestic automobile manufacturers (Ford, GM, and Chrysler). Underlying the stated technical goals for the partnership was a more fundamental goal: to improve the relationship between the federal government and the U.S. auto industry.

This dissertation provides a detailed case study to assess: (a) the effect of PNGV on the relationship between government and the U.S. automotive industry, and (b) the effect of PNGV on cooperation and other characteristics within the automotive industry. The quality of the PNGV relationships is gauged in various ways, including the nature and frequency of communication, the level of understanding and trust between participants, and the ability to work through differences to achieve their shared goals.

In addition to the assessments noted above, in the course of conducting this research this dissertation highlights evidence of the Partnership’s influence on the industry and market for vehicles with alternative technologies, as well as its potential as a model for cooperation in the automobile industry and elsewhere.
Data and Methods

This dissertation addresses these hypotheses by examining the Partnership as a multi-source case study, building upon a wide variety of documentation, interviews, and other sources compiled over 15 years. Documentation included program materials from government and industry, articles, studies, and Congressional testimony. Original interviews permitted the targeted collection of opinions and attitudes of participants and observers, including nine individuals from government who helped create or manage the partnership and 13 industry managers and engineers, including some from each of the Big Three firms.

Hypothesis 1: PNGV improved the relationship between government and the U.S. automotive industry

This dissertation finds that PNGV was a significant factor in improving the relationship between the government and the Big Three. There was abundant evidence of the antagonistic relationship between government and industry in the decades prior to PNGV. Many articles, reports, and original interviews noted that the government-industry relationship improved during the 1990s, and none suggested that PNGV had a negative influence on this relationship. Some of those articles and other sources, including most individuals interviewed for this dissertation, specifically attributed the positive changes in the relationship to PNGV.

The dissertation also documents some of the mechanisms used in this cooperative approach, showing that working relationships improved at both technical and managerial levels. Most participants pointed to improvements in technical interactions in particular, largely among engineers and scientists facing common challenges.
Hypothesis 2: PNGV improved the relationships among the Big Three.

The dissertation also finds specific ways in which the cooperation among the Big Three improved, but it is unable to conclusively attribute these improvements to PNGV. The improvements in the relationships among industry stakeholders seem particularly apparent in the context of technical interactions.

A Conceptual Model of How Institutional Relationships Build on Their Interactions

The dissertation explores how its specific components of these relationships functioned. The dissertation represents the partnership as a dynamic, iterative process of interactions in which each round of interactions would contribute to evolving attitudes toward partners and further interactions with them. In this way we see how improvements in understanding, attitudes, interactions, and processes that occur during cooperative efforts help enable the success of future interactions, even after the end of the partnership itself.

The Broader Impact and Influence of PNGV

Additionally, this case study indicates some support for two other effects of PNGV. First, PNGV may have had some positive side effects in its marketplace by sparking the interest of non-PNGV participants in developing and marketing alternative automotive technologies. This in turn may further have promoted domestic interest in these technologies. Some analysts go as far as to say that PNGV sparked a race among domestic and foreign OEMs to pursue these technologies.

Second, beyond the context of the automotive industry, the Partnership broke new ground in defining institutional arrangements that are possible between government and
industry. Various sources noted PNGV’s possible role as a model for R&D cooperation in general, and indeed some subsequent government-industry efforts overtly borrowed from PNGV’s organizational approach.

**Final Observations on PNGV and Government-Industry R&D Partnerships**

The following are four observations on PNGV’s implementation and history that may provide lessons for future government-industry R&D partnerships. While these are drawn from the work of others, each is supported by the original research conducted for this dissertation.

- In defining partnership goals, policy makers balance clarity, accountability, and robustness.
- Other policy tools may be needed to complement the efforts of R&D partnerships despite any improvement in a government-industry relationship.
- Partnership developers and participants should keep in mind that each participating organization has distinct motivations that will guide its behavior.
- Each partnering organization should encourage and enable staff communication and coordination, especially when working with nontraditional allies.

Ultimately PNGV failed to achieve its technical goals. The Bush administration ended PNGV in 2002 and replaced it with the FreedomCAR initiative. It is clear that PNGV did not succeed in positioning the Big Three as industry leaders in developing alternative technologies, and recent economic crises have left the future of the Big Three unclear.

Overall, PNGV provides a cautionary tale for implementing federal technology policies and partnerships. The hope of this author is that this dissertation will provide encouragement for future efforts in pursuing collaborative approaches, as well as practical observations on specific aspects of a partnership to emulate or avoid.
ACKNOWLEDGEMENTS

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CHAPTER 1: INTRODUCTION

At the 2000 Detroit Auto Show General Motors, Ford, and DaimlerChrysler each unveiled prototypes for ultra-efficient automobiles that could be available early in the next century. These vehicles exhibited dramatically improved efficiency and emissions characteristics resulting from their use of advanced technologies such as fuel cells and advanced batteries. While prototype vehicles using alternative technologies are typical at auto shows, such new technologies had previously focused primarily on performance or safety characteristics. The developments in efficiency and emissions characteristics that started to appear at that time resulted in part from a research partnership between the “Big Three” domestic automobile manufacturers\(^1\) and the federal government called the Partnership for a New Generation of Vehicles.

The Partnership—often referred to simply as PNGV—was established in 1993 as one of a series of White House efforts aimed at supporting research and development (R&D) toward the goal of building more competitive domestic industries. The effort, also known at times as the "super-car" or "clean car" initiative, had the added objective of motivating technologies associated with increased fuel efficiency and lower emissions.\(^2\) However, the goals for the Partnership went beyond developing technology. The stated

\(^1\) The “Big Three” has long referred to the largest domestic auto manufacturers: General Motors Corporation, Ford Motor Company, and Chrysler Corporation. From 1998 to 2007 Chrysler was part of a merged DaimlerChrysler. In 2007, Chrysler LLC was formed as Daimler AG divested itself of major interest in the Chrysler Group. (National Research Council (NRC), Review of the Research Program of the FreedomCAR and Fuel Partnership: Second Report, Washington: National Academy Press, 2008, p. 17.)

\(^2\) During the George W. Bush administration, many aspects of PNGV changed as it was reinvented as the FreedomCAR initiative. While the focus was shifted to Department of Energy automotive research on fuel cells and hydrogen technologies, many aspects of the partnership persisted in the reformulated initiative. These developments are summarized but not analyzed in detail in this study, which focuses on PNGV.
goals may be summarized as follows: (1) to improve national competitiveness in manufacturing, (2) to implement in conventional vehicles commercially viable innovations from ongoing research, and (3) to develop vehicles that can achieve up to three times the fuel efficiency of comparable family sedans, while maintaining or improving other vehicle characteristics.

While the three explicit goals provided specific areas towards which the Partnership should strive, behind the goals and the cooperation stood a purpose at least as important as the goals themselves: to motivate a change in the relationship between the federal government and the auto industry. Then-President William Clinton spoke on the promise of the Partnership in 1993: “[PNGV] represents a major step in breaking down the decades of mistrust between the federal government and the Big 3 over fuel economy, emissions, and safety issues. Whether a new car is invented or not, the agreement will break down the wasteful gridlock over regulation of the automobile industry.”

Similarly, the 1993 PNGV announcement by the White House stated, "This program represents a fundamental change in the way government and industry have interacted in the past and is intended to begin a new era of progress through partnership to address the nation's goals rather than through the confrontational and adversarial relationship of the past.”

The Big Three made a number of technological accomplishments through the Partnership, but the focus of this research is on the effects of the Partnership beyond the technical goals of PNGV. Specifically, this dissertation explores the following aspects:

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1. The effect of PNGV on the relationship between government and the U.S. automotive industry and
2. The effect of PNGV on cooperation and other characteristics within the automotive industry.

Additionally, in the course of interviews and other data collection, this dissertation highlights evidence of the influence of the Partnership, not only on the industry and market for vehicles with alternative technologies, but also as a model for cooperation, both in the auto industry and in other industries.

Chapter 2 of this dissertation provides a background on the U.S. automotive industry at the time of PNGV’s creation, including the government policies that enabled or affected it. Chapter 3 summarizes the creation of PNGV, including a brief overview of its design. Chapter 4 lays out a theoretical overview of the effects of policies on industries, both broadly and specific to PNGV and the auto industry. Chapters 5 and 6 discuss the hypotheses of this dissertation and the data and methods used to address them. Chapter 7 examines PNGV in the context of other government-industry partnerships through the 1990s. Chapters 8 and 9 look at the effects of PNGV on institutional relationships within government and industry, and Chapter 10 looks at some of the mechanisms at work within these relationships. Chapter 11 explores certain aspects of the influence PNGV had on organizations, technologies, and markets; and Chapter 12 provides the conclusions of this dissertation.

Time has passed since the creation of the Partnership, and during the Bush administration it evolved into the FreedomCAR initiative. Within the marketplace, it is clear the Big Three have not led the industry in developing alternative technologies. Foreign automakers were responsible for the most successful introductions of hybrid-electric vehicles to the marketplace starting in the late 1990s, and the Prius has become
among Toyota’s most noteworthy vehicles. Meanwhile, as this dissertation is being written, economic crises affecting the automotive industry leave the future of the Big Three unclear, and some assert the future of these companies may rest with their success in moving to alternative technologies.5

However, regardless of the failure of the Big Three to leverage PNGV into market leadership of alternative vehicle technologies, the institutional lessons from the PNGV experience—both positive and negative—are significant for both the automotive industry and other technology partnerships between government and industry.

One cannot fully comprehend the Partnership for a New Generation of Vehicles as a policy approach without first considering the historical context in which it was implemented. In 2009 our thoughts of the domestic auto industry are very different from what they would have been in 1992, when the automotive partnership was first envisioned.

To provide that context to begin this analysis, consider the automotive industry of 1992. The Big Three were among the strongest players in the market for passenger vehicles in the U.S. and internationally. Sport utility vehicles were present in the marketplace, but did not yet dominate. Following fears of Japanese economic ascendancy in the 1980s, there was lingering protectionist sentiment in the U.S. Few consumers had ever heard of a “hybrid” vehicle. The primary modes of federal government interaction with the domestic auto industry had been regulatory mandates, most notably through the Corporate Average Fuel Economy (CAFE) standards and safety requirements.

The U.S. automotive industry has long been one of the largest industries in the world, providing a key component to U.S. industrial strength. Many government policies affect this industry directly, involving a wide array of issues, including safety, pollution, energy efficiency, and industrial competitiveness. This analysis of PNGV in this chapter begins with a review of the relevant social and policy context in which PNGV was designed and implemented in the early 1990s. This chapter profiles the automotive industry, chronicles the history of the regulatory and other interaction between the
government and the auto industry, and concludes with an overview of the factors that set the stage for a shift in policy.

The Automotive Industry in the U.S.

Clearly the U.S. automotive industry is significant regionally, nationally, and globally. This section provides a number of statistics on the U.S. automotive industry at the time of the beginning of PNGV in the early 1990s, to provide some context for the creation and evolution of PNGV.

The automobile has long been central to American way of life; at any given time since 1988, there have been over 120 million cars in use in the U.S. That is the equivalent of one car for every two people in the country, or 1.2 cars per household.1 Worldwide, the Big Three typically produce about six million passenger cars each year, which translates to a new car every five seconds.2 In the 1990s, General Motors and Ford consistently ranked first and second among manufacturers in numbers of vehicles produced each year worldwide.3

With respect to sales, the automotive industry has long been the largest manufacturing industry in North America, with automotive purchases accounting for 4.5 percent of the Gross Domestic Product (GDP) each year in the 1990s.4 In the early

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3 Producers ranked third through sixth have varied over the years, but they have generally included Toyota, Chrysler, Volkswagen, and Nissan (AAMA, Motor Vehicle Facts & Figures 1995, Washington: American Automobile Manufacturers Association, 1995, p. 14).
4 The reader should be alert to distinctions among classifications of vehicles used in automotive statistics: cars, cars and light trucks, and motor vehicles (which typically include buses and heavy trucks). Some regulations distinguish between cars and light trucks, though regulations for those vehicle classes
1990s, the Big Three were responsible for over 70 percent of car and light truck sales in the U.S.\(^5\) Cars and associated costs have been responsible for about 15 percent of consumer spending, on average.\(^6\) General Motors, Ford, and Chrysler are among the top U.S. industrial exporters.

By some estimates, the auto industry of the 1990s was responsible for over two million jobs directly and in related industries such as advanced materials and electronics.\(^7\) As many as six to seven million jobs have been dependent on the auto industry, directly and indirectly, accounting for five to seven percent of employment in the U.S. in the 1990s.\(^8\) Of the nation’s use of raw materials, the automotive industry has accounted for nearly 70 percent of lead and rubber, and 15 to 30 percent of iron, aluminum, steel, and zinc.\(^9\)

In 1992, R&D expenditures in the U.S. auto industry totaled $12.3 billion, which was the second highest of all U.S. industrial sectors.\(^10\) Of that total, GM and Ford’s contributions were the first and third highest of R&D expenditures of all U.S.

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\(^6\) AAMA, 1995, p. 61.
\(^8\) In 1992, the 6.8 million jobs related to the industry represented 7.3% of total U.S. employment (AAMA, 1995, p. 71). Some find estimates of “related industries” questionable, due to interpretations of employment categories (U.S. Congress, Office of Technology Assessment (OTA), *Advanced Automotive Technology: Visions of a Super-Efficient Family Car*, Washington: U.S. Government Printing Office, 1995, p. 1). Of the number provided, there are just over 1,000,000 salaried and hourly employees directly employed in motor vehicle and equipment manufacturing.
\(^9\) AAMA, 1995, p. 54.
\(^10\) As the purpose of this discussion is to provide historical context for PNGV, I emphasize the period leading up its creation in 1993. Consequently, industry statistics are from that period except where otherwise noted.
companies.\textsuperscript{11} While Big Three R&D expenditures reached all-time highs, the wide-ranging basic research activities that once took place in their labs have declined dramatically.\textsuperscript{12} Most automotive R&D spending is tied to product development, and most of those expenditures are during the 18 months leading up to the unveiling of the new product. One exception to the dominance of product-related R&D is the increasing R&D spending toward improving manufacturing processes. At the same time, the Big Three are relying more on suppliers for parts and even integrated component systems.\textsuperscript{13}

Geographically, most of the divisions and plants of the domestic automakers and their suppliers are clustered within the Midwest, not far from Detroit. Indeed, some analysts feel the lack of geographical proximity among the auto manufacturers in the European Union may have posed a barrier to its efforts to implement a PNGV-like initiative (in addition, of course, to issues of culture, language, historical biases, etc.).\textsuperscript{14}

The automotive industry has been international from the beginning. In 1914, Ford was already the largest producer of vehicles in Britain.\textsuperscript{15} Meanwhile, individual companies have become increasingly multi-national. In the 1990s, Honda surpassed Chrysler in car production in the U.S., while Ford and GM each outsold most other brands in Europe.\textsuperscript{16} A combination of transplant factories and international corporate mergers (such as that of DaimlerChrysler in 1998) was responsible for this trend. In general, the numerous consolidations and reorganizations experienced among the

\textsuperscript{12} AAMA, 1998, p. 79; Council on Competitiveness, 1996, p. 54.
\textsuperscript{13} Council on Competitiveness, 1996, pp. 52 and 55.
automakers over the years have resulted in a more and more concentrated market over time.

As significant as the U.S. automotive industry is, by the 1990s it was clear it no longer enjoyed its once unquestioned dominance in the world market. In *The Machine That Changed the World*, the authors chronicle the decline of the western dominance in automotive manufacturing, due in part to inefficiencies in the traditional methods of mass production. In terms of market share of U.S. vehicle sales, the Big Three dropped from nearly 100 percent of sales in 1955 to 86 percent in 1970 and to under 70 percent in 1990.17

Thus, the automotive industry is extremely important to our economy and our way of life, and the dominance of the Big Three in the market has slid over time. It is no surprise that industrial competitiveness in this industry was and is of great concern. Likewise, federal policies that affect the industry can have large effects in any number of related areas, domestically and worldwide. Nevertheless, the millions of automobiles on the road contribute to a number of negative effects on society, which have motivated a long series of federal automotive policies. The rest of this chapter examines these effects and the government policies they have motivated.

Public Opinion and Government Policy

In 1908, the British Royal Commission on the Motor Car noted as a particular problem the tendency of motor vehicles to churn up dust on un tarred roads. While airborne dust was undoubtedly a problem for that time, the emphasis on it as a noteworthy automotive issue illustrates how perceptions can change over time regarding technologies and their side effects.

The last century saw large ebbs and flows in attitudes—and resulting government policies—toward automobiles, the industry that manufactures them, and the road and highway infrastructure they use. These changes of attitude fall into several discernible periods over time. Through the 1950s, the era of the car culture, attitudes in the U.S. towards the automobile had been favorable with few exceptions. Car ownership was considered to be a fundamental part of the American dream.

In the 1960s, Ralph Nader and others highlighted a need for increased attention to the safety of the automobile. The industry’s response turned into a public relations nightmare, and a decided anti-auto-industry sentiment took hold for the public and Congress.

In 1974, Bradford Snell, assistant counsel for the U.S. Senate Subcommittee on Anti-Trust and Monopoly, Committee on the Judiciary, prepared a report calling for laws to diminish the power of the auto industry. He asserted that the industry had undercut

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automotive alternatives, for example, in conspiring in the demise of streetcar lines.\textsuperscript{22} While some have characterized Snell’s assertions of conspiracy to be oversimplified or inaccurate, the idea persists.\textsuperscript{23}

Meanwhile, environmental groups and other anti-auto advocates have rallied against the automobile in a number of ways since the 1960s. In 1992, the World Resources Institute published one of the most widely read sources on the topic in recent years: \textit{The Going Rate: What It Really Costs to Drive}.\textsuperscript{24} It notes the large hidden subsidies enjoyed by the automotive industry. Some find the inclusion of certain costs to be questionable, including, for example, $25 billion in annual defense expenditures for the protection of oil supplies and $85 billion in employer-provided parking subsidies.\textsuperscript{25} Still, the general point remains that there are indeed large costs associated with maintaining and protecting this significant industry.

Throughout this debate, federal automobile policy has repeatedly shifted focus. Table 2-1 demonstrates several such shifts over time, in each case noting the problem, the solution approach, and the type of policy each solution represents. The table includes the following types of policies:

- Promotion: public incentives, such as matching funds and tax breaks
- Regulation: rules or mandates that tend to increase producer costs
- Protection: actions that increase, restore, or shift demand for industry or mode of transportation.

\begin{itemize}
\item \textsuperscript{23} Dunn, 1998, pp. 8-9.
\item \textsuperscript{24} James J. MacKenzie, Roger C. Dower, and Don Chen, \textit{The Going Rate: What It Really Costs to Drive}, Washington: World Resources Institute, 1992.
\item \textsuperscript{25} Dunn, 1998, p. 16.
\end{itemize}
This range of activities is not surprising. It should come as no surprise that there is some correlation between shifts in public attention and trends in government intervention shown in the table. One of the primary roles of the government, after all, is to act for the public good. While much of economics is based on the concept of free markets, there are instances where industry practices or products are not consistent with the greater public good. Known as externalities, examples in the automotive industry include vehicle emissions and other problems associated with gasoline consumption, such as energy dependence. To the extent that a free market does not incur the costs of externalities it creates, there is a market failure.

Table 2-1: Trends in Federal Automobile Policies Prior to PNGV

<table>
<thead>
<tr>
<th>Problem</th>
<th>Policy solution</th>
<th>Policy Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate roads (1916-1932)</td>
<td>Federal financial assistance to states for road construction</td>
<td>Promotion</td>
</tr>
<tr>
<td>Congestion (1956-1965)</td>
<td>Interstate highways; highway trust fund</td>
<td>Promotion</td>
</tr>
<tr>
<td>Decline of other modes (1964-1980)</td>
<td>Transit and train subsidies</td>
<td>Protection</td>
</tr>
<tr>
<td>Pollution (1963-1992)</td>
<td>Clean air standards</td>
<td>Regulation</td>
</tr>
<tr>
<td></td>
<td>Automotive technology programs</td>
<td>Promotion</td>
</tr>
<tr>
<td>Industrial competition (1980-1984)</td>
<td>Import quotas; regulatory rollback</td>
<td>Protection</td>
</tr>
<tr>
<td>Intermodal transit and transportation concerns (1991)</td>
<td>Flexible, intermodal funding; holistic transportation planning</td>
<td>Protection</td>
</tr>
</tbody>
</table>

However, externalities such as automotive emissions or fatalities from auto accidents are as old as the automobile; why would there be such a delay in federal intervention? A shifting public perception of externalities may explain shifts in federal

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26 Table adapted from Dunn, 1998, pp. 21, 55; with additions based on OTA, 1995, Table 5-1, p. 263.
policy focus over time. As the role of the government is to act for the public good, the government will only act as the public perceives the need. More specifically, the externalities associated with the automobile were not the matter of legislation until public perception was significantly strong (and political factors aligned to promote their treatment by government regulation and other interaction). Among the issues addressed in Table 2-1, four of particular relevance to PNGV are safety, the environment, energy consumption, and industrial competition. The following discussions profile federal policies in the years leading up to PNGV in each of these areas, in addition to technology policies that cut across all of these issues.

Automotive Safety

In 1956, the Ford Motor Company offered an optional safety package that consisted of lap belts, crash padding, and a special steering wheel, door latches, and sun visors. Not only did the package sell poorly, but in that same year, competitor Chevrolet nearly tripled its sales lead. This market performance led Ford and others to the conclusion that "safety doesn't sell."27

During the 1960s, rising auto accident fatalities increasingly brought safety into focus. States began to issue laws requiring the provision of front seat belts. Facing rising political pressure at the federal level, by 1964 American automakers provided front seat belts as standard equipment.28 In 1965, consumer advocate Ralph Nader published

27 John D. Graham, *Auto Safety: Assessing America's Performance*, Dover, Mass.: Auburn House Publishing Company, 1989, p. 62. (Graham notes that this conclusion is debatable, as the large engine and flashy wheels of the competition may have been the deciding factor.)

28 While lap belts were not federally mandated at that time, it appears that the automakers were motivated by a combination of the state standards and the inevitability of federal requirements. Lawrence J. White, *The Automobile Industry since 1945*, Cambridge: Harvard University Press, 1971, p. 241.
Unsafe at Any Speed, calling for increased automotive safety awareness and government standards. The following year, the Motor Vehicle Safety Act authorized the National Highway Traffic Safety Administration (NHTSA) of the Department of Transportation to initiate federal safety standards. Mandates on front shoulder belts and headrests and rear lap belts followed in 1968 and 1969. The auto companies responded by accelerating their safety research.

Table 2-2 shows some of the safety standards set by the federal government. It also shows evidence of the power of the automotive industry, as standard after standard was subsequently revoked. The perception that safety features would not increase consumer demand caused the automakers to strongly resist the most demanding federal standards.

**Table 2-2: Primary Federal Automotive Safety Regulations**

<table>
<thead>
<tr>
<th>Year</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>The National Traffic and Motor Vehicle Safety Act initiates safety standards</td>
</tr>
<tr>
<td>1970</td>
<td>NHTSA mandates passive restraints; later revoked</td>
</tr>
<tr>
<td>1975</td>
<td>Anti-lock brakes mandated for heavy trucks; later revoked</td>
</tr>
<tr>
<td>1976</td>
<td>Passive restraint mandate reissued; again revoked</td>
</tr>
<tr>
<td>1984</td>
<td>Passive restraint mandate reissued</td>
</tr>
<tr>
<td>1991</td>
<td>Mandate issued on driver and passenger airbags by 1998</td>
</tr>
</tbody>
</table>

In 1970, NHTSA mandated passive restraints such as air bags, realizing that federal mandatory seat belt usage laws were politically infeasible. Automakers complained of prohibitive costs, Nixon interceded, and the mandate was rescinded.

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Meanwhile, General Motors voluntarily offered optional air bags in 1974. GM soon withdrew from the air bag market, disappointed with sales. In 1977, the NHTSA standard was reissued to mandate some sort of passive restraint, only to be again revoked in 1981 by President Reagan. A Reagan campaign speech in Detroit noted that "federal regulations are the cause of all your problems." Following a federal appeals court judgment, the mandate was reissued in 1984. At this time, automakers opted for passive restraints other than air bags, such as automatic seat belts. Eventually, each of the Big Three began to offer air bags and/or anti-lock brakes in certain models, responding in part to foreign competition and increasing consumer demand. In 1991, Congress strengthened the mandates to require both driver and passenger side bags in all new cars by 1998. Federal requirements on automotive safety have steadily increased since the 1960s, and they do not appear to be subsiding.

Emissions

Attention to automobile emissions originated in the late 1950s with local legislation in urban areas (resulting, for example, in the first California anti-pollution law in 1960). National attention followed, yielding the Motor Vehicle Air Pollution and Control Act of 1965. Amendments to the Clean Air Act have increased emissions

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31 Other, less ambitious standards have succeeded. By the 1980s there were more than fifty separate NHTSA standards for passenger vehicles. See Robert W. Crandall et al., Regulating the Automobile, Washington: The Brookings Institution, 1986, p. 3.
standards further since the 1960s. This and other relevant historical federal legislation through the early 1990s is shown in Table 2-3. Note that unlike safety standards, which generally are set by an Executive Branch regulatory agency, emissions standards have been set by Congress.

Table 2-3: Primary Federal Emissions Regulations

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>The Clean Air Act provided the first federal legislation on air quality</td>
</tr>
<tr>
<td>1965</td>
<td>The Motor Vehicle Air Pollution and Control Act of 1965 authorized emissions standards for all new vehicles</td>
</tr>
<tr>
<td>1966</td>
<td>The Department of Health, Education, and Welfare set automobile emissions standards to take effect in 1968</td>
</tr>
<tr>
<td>1970</td>
<td>The Clean Air Act of 1970 required 90% reduction of emissions by 1976</td>
</tr>
<tr>
<td>1970</td>
<td>Environmental Protection Agency created</td>
</tr>
<tr>
<td>1977</td>
<td>The Clean Air Act of 1977 authorized extension to meet emissions standards</td>
</tr>
<tr>
<td>1990</td>
<td>The Clean Air Act Amendments of 1990 required further emissions reductions, cleaner fuels, longer warranties on pollution controls</td>
</tr>
</tbody>
</table>

Perhaps the most ambitious and controversial of recent policies has been at the state level. Since 1970, California has consistently led the country in setting strict emissions standards on vehicles sold in the state. In 1990, the requirements issued by the California Air Resources Board (CARB) mandated zero-emission vehicles (ZEVs) as an increasing share of cars offered for sale in California. Similar requirements were placed on low- and ultra-low emission vehicles (LEVs and ULEVs). Other states introduced similar measures, following California’s lead. Though the requirement was eventually relaxed, the policy was unique in breaking out specific ratios for vehicles with specific emissions characteristics. It was also noteworthy in setting requirements so strict in some

37 Dunn, 1998, pp. 74-75.
cases as to effectively mandate specific technological solutions (such as electric vehicles).

In addition to enacted federal legislation and potential mandates on vehicle technologies, other regulatory solutions to air pollution considered in the literature include incentives for or mandates on modified fuels (such as oxygenated fuels, which reduce certain types of emissions)\textsuperscript{38} or on technologies that require alternative fuels (such as natural gas, hydrogen, or electricity). Indeed, some such policies have existed for special niches, such as government and corporate vehicle fleets. Small-scale, incentive-based policies for alternative technologies (such as electric vehicles) are not uncommon at the state or local level.\textsuperscript{39}

In recent years, environmental concerns have expanded from urban and localized vehicular pollution to more global issues. The rise of alternative technologies brings increased concerns for the effects of generating alternative fuels such as electricity or hydrogen. Since the late 1980s, concerns for the global effects of so-called “greenhouse gases” have increased dramatically.\textsuperscript{40}

Of course, many of the standards set or proposed are also relevant to other automotive issues, such as fuel consumption and technology policies, discussed below. Similarly, alternative fuels and technologies each have their own safety considerations (flammability, toxicity, etc.) that create tensions between emissions standards and safety issues.

\textsuperscript{38} The effectiveness of oxygenated fuels is the subject of continuing debate (e.g., Gordon, 1991, p. 94).
\textsuperscript{39} There are many non-financial incentives, including preferential parking and exemption from high-occupancy vehicle lane restrictions.
\textsuperscript{40} The 1990 Clean Air Act Amendments include provisions for mobile emissions of greenhouse gases.
Fuel Consumption

Attention to automotive fuel consumption increased in response to the oil crises of the 1970s and 1980s. Specifically, this increased attention was due in part to the oil embargo that highlighted a dependency on foreign energy sources, and in part to the resulting rise in popularity for small, mostly foreign, fuel-efficient vehicles. Environmental concerns regarding pollution and non-renewable energy sources added to the debate.

Given such a wide array of concerns, what policies might be used to reduce fuel consumption? A 1974 RAND Corporation study demonstrated that increasing gasoline prices was the only effective way of reducing short-term consumption of gasoline. The study notes an almost 1:1 relationship between gasoline tax increases and gasoline consumption decreases—the authors estimate that for every percent increase in tax imposed, gasoline consumption would be reduced by one percent.41 While they note some potential long-range negative impacts of gas taxes, such as economic effects of decreased car sales, the authors make a strong case for the effectiveness of such a tax, and other studies support that claim.42

Why, then, has the U.S. not increased taxes on gasoline more dramatically? The most recent increase in 1993 resulted in a federal tax of 13.8 cents per gallon. By comparison, a survey of countries in the Organization for Economic Cooperation and Development (OECD) shows tax rates of several times as much, where in each case the

41 This relationship, in 1974 dollars, was predicted to continue through the first five years of the tax. The authors note that delays in implementing the tax affect its effectiveness relative to alternative policies. Sorrel Wildhorn, Burke K. Burright, John H. Enns, and Thomas F. Kirkwood, How to Save Gasoline: Public Policy Alternatives for the Automobile, Cambridge: Ballinger Publishing Company, 1976, p. 138.
tax component of the price accounts for more than half of the total price. For example, in 1992 the price of gasoline in the U.S. was about $1.25 per gallon, of which taxes contributed less than a third of the price. By comparison, Canada had the next highest gas prices of over $1.50 per gallon (nearly half of that due to taxes), and the highest prices were in Norway with a price of over $4.50 per gallon (about two-thirds of the total due to taxes). In France, the price without taxes was less than $1.00 per gallon—only slightly over that of the U.S. or Canada—but taxes added approximately $3.00 per gallon.  

The reason gas taxes have not increased significantly is primarily political. Few politicians would care to make a firm stand that would be so unpopular among the voters. Authors Nivola and Crandall contend that the relatively low gas taxes in the U.S. persist not because of political shortsightedness, but rather from a historical legacy of our particular culture and regulatory regime that is difficult to overcome. Furthermore, whenever gas taxes have been implemented throughout the world, most have been motivated by the potential for increased revenues, rather than decreased fuel consumption.

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44 Note that individual states also tax gasoline, in some cases, though the net result is still much lower taxes than in most other countries.
45 In recent decades, gas taxes have become a partisan issue. President Clinton’s gas tax succeeded despite receiving no Congressional Republican votes, and a proposed repeal of the tax was briefly an issue in the 1996 presidential elections. Historically, however, many gas taxes in the U.S. have been approved by Republican administrations. (Dunn, 1998, p. 44.)
Since 1970, federal regulators have set their sights on the characteristics of vehicles offered for sale, rather than taxes on gasoline. Policies for reduced fuel consumption have primarily emphasized increased fuel efficiency, as summarized in Table 2-4. At the time of the Clean Air Act of 1970, the fleet average for new American-made cars was 14 miles per gallon (mpg).\textsuperscript{48} The corporate average fuel economy (CAFE) standards of the 1975 Energy Policy and Conservation Act increased those standards to 27.5 mpg by 1985. As noted in Table 2-4, these standards held, though they were eventually delayed to 1990.\textsuperscript{49} Also shown is the 1973 enactment of the national speed limit of 55 mph, as a means of conserving energy, as well as the so-called “gas guzzler” tax that penalized manufacturers for car models with poor fuel efficiency. Tax breaks on alcohol-based fuels such as ethanol and methanol were also implemented in the 1970s, to increase the purchase of fuels generated in part from biomass.\textsuperscript{50}

Table 2-4: Primary Federal Fuel Consumption Regulations

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>Congress imposed a national 55 mph speed limit to conserve energy\textsuperscript{51}</td>
</tr>
<tr>
<td>1975</td>
<td>The Energy Policy and Conservation Act created CAFE standards: 27.5 mpg required by 1985</td>
</tr>
<tr>
<td>1980</td>
<td>“Gas guzzler” tax imposed</td>
</tr>
<tr>
<td>1985</td>
<td>Reagan administration reduced CAFE standard to 26 mpg for 1986-88</td>
</tr>
<tr>
<td>1989</td>
<td>G.H.W. Bush administration set CAFE standard at 27.5 mpg by 1990</td>
</tr>
</tbody>
</table>

Additionally, as environmental and fuel consumption issues overlap, many of the emissions regulations previously noted are also relevant to fuel consumption. However,

\textsuperscript{48} Gordon, 1991, p. 15.
\textsuperscript{49} Dunn, 1998, p. 21, except as noted. The CAFE standard for passenger vehicles has not changed since 1990, but there have been some changes for light trucks.
\textsuperscript{50} Gordon, 1991, p. 90.
\textsuperscript{51} Gordon, 1991, p. 122.
not all fuel consumption policies improve emissions. For example, policies that target alternative fuels such as alcohol or natural gas may discourage other fuels and technologies that are cleaner or more efficient.\textsuperscript{52} The discussion of government automotive technology efforts below also introduces other policies that may affect fuel consumption.

Interestingly there is also some overlap between safety and fuel efficiency. Some have argued that CAFE standards may have worked against automotive safety, since they tend to discourage production of large family vehicles\textsuperscript{53} and because the reduced vehicle weights they promote are less safe on the average.\textsuperscript{54} Additionally, many of the technologies that could be used to create cars with better fuel economy were instead used to create cars with greater acceleration (e.g., turbo-assisted vehicles), which are statistically less safe.\textsuperscript{55}

Other regulatory solutions for fuel efficiency have been attempted or considered in the literature, including incentives for purchase of fuel-efficient vehicles (as noted in the discussion of emissions policies).

**Industrial Competition**

In the 1950s, Charles Wilson, the President of General Motors and nominee for Secretary of Defense, is credited with proclaiming that “What’s good for GM is good for

\textsuperscript{52} Gordon, 1991, p. 76.
\textsuperscript{55} Gordon, 1991, p. 122.
the country.” Though this is not an exact quotation,\textsuperscript{56} the sentiment seems to have been reflected in federal policy over the years. Federal industrial policies often protect certain industries, due to their effect on the economy. Given the great significance of the Big Three in the country and the world, it follows that the statement attributed to Wilson often has held politically.

In 1980, the auto industry experienced a dramatic slump in sales. The next year, President Ronald Reagan announced a sweeping rollback of 34 regulations that affected the auto industry. Reorganizations and cuts among agencies such as NHTSA and the Environmental Protection Agency (EPA) were quickly carried out.\textsuperscript{57} Meanwhile, voluntary trade restrictions were negotiated with Japan.

In the late 1980s and early 1990s, an economic slowdown again affected the U.S. automakers’ profitability. Early in 1993, Japan was the world’s top producer of automobiles, accounting for 34.7 percent of worldwide production.\textsuperscript{58} While federal policy-makers considered how to maintain industrial strength, many of the traditional trade policies and other protectionist tools not in play had been considered and rejected, and new options were limited. Factoring in the concerns on the rise at the same time in other automotive issues (discussed above), the problem became even more difficult.

\textbf{Technology Policy}

In the decades following World War II, the U.S. government approach to investment in science and technology was shaped by Vannevar Bush’s report to the

\textsuperscript{56} Dunn, 1998, p. 52. (When asked if he saw conflicts with his career in the auto industry and his proposed position on President Eisenhower’s Cabinet, Wilson said, “I have always thought that what was good for the country was good for General Motors, and vice-versa.”)

\textsuperscript{57} Dunn, 1998, pp. 63-64.
President, *Science: The Endless Frontier*. Professor Lewis Branscomb summarizes this approach as having five underlying principles:

1. Basic scientific research is a public good.
2. Federal agencies should pursue development of new technologies for use in their missions, and that such development will automatically “spin off” to commercial users.
3. The government should refrain from directly investing in research to create technology specifically for commercial exploitation, thereby leaving market forces uncompromised.
4. The government should rely on regulations to force private investment in environmentally beneficial technologies.\(^6^0\)
5. Science and technology can be viewed as assets to be deployed internationally in support of the goal of containing the Soviet Union.\(^6^1\)

Note that principles (3) and (4) promoted the use of regulation instead of direct investment to affect the market in instances of market failure. Commercial applications were meant to be left to industry and market forces, though there is nothing to prevent their indirect flow from federal research and development.

As a final factor to add to these principles, a recurring theme in U.S. culture and policy is the emphasis on technology in solving problems. This theme goes back to the Second World War, certainly, but elements can be traced to the 19th Century’s rapid development of railroads to span the country, the development of infrastructure for lighting and communication, the development of aviation, etc. While many of these developments had global elements, the U.S. could be said to have come of age alongside the industrial revolution, which has instilled in the American mind an interest in if not

\(^{60}\) Branscomb specifically speaks of the environmental costs and benefits of technology, but the point can be more generally applied to any externalities that motivate government regulation.
dependence on technological solutions. Going beyond the principles Vannevar Bush outlined for the goal of maintaining strong industries and defenses, the U.S. appears to value technology as an end in itself.

In this context, U.S. policy grew increasingly complex to address changing perceptions of the automotive industry, its societal impact, and policies considered appropriate, as shown in Table 2-5. Still other federal automotive technology efforts have existed, such as the work with intelligent vehicle and transportation systems, but the goals for such efforts have little in common with those of PNGV, even if the general approach is not completely dissimilar.

Table 2-5: Federal Automotive Technology Policies Relevant to PNGV

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>Clean Air Act Amendments of 1966 supported cleaner technologies for internal combustion engines and the development of electric vehicles</td>
</tr>
<tr>
<td>1974</td>
<td>The Energy Reorganization Act and the Non-Nuclear Energy R&amp;D Act promoted design and commercialization of electric and hybrid vehicles</td>
</tr>
<tr>
<td>1976</td>
<td>The Electric and Hybrid Vehicles Research, Development, and Demonstration Act launched the government’s Electric and Hybrid Vehicle Program</td>
</tr>
<tr>
<td>1978</td>
<td>The Department of Energy Act of 1978 included broad technology and fuel options, and the Automotive Propulsion Research and Development Act of 1978 formalized DOE’s automotive research program</td>
</tr>
<tr>
<td>1992</td>
<td>The Energy Policy Act of 1992 authorized electric and hybrid vehicle demonstrations and infrastructure development, provided tax credits for EV purchases; and mandated alternatively fueled fleet vehicles</td>
</tr>
</tbody>
</table>

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62 OTA, 1995, p. 263.
In a 1970 address on the environment, President Nixon called for the production of “an unconventionally powered, virtually pollution free automobile within five years.”\(^{63}\)

Though such developments were slower than hoped, federal research in relevant technologies has progressed intermittently. The U.S. Department of Energy (DOE) has long performed research relevant to automotive propulsion, most notably resulting from the Electric and Hybrid Research, Development, and Demonstration Act or 1976.\(^{64}\) As part of its Electric and Hybrid Vehicle Program, the national laboratories of DOE performed research according to their respective missions, with limited input and no direction from the U.S. auto industry. Many of the research programs sponsored by President Carter were reduced or eliminated under President Reagan.\(^{65}\)

Why are auto manufacturers hesitant to make changes in vehicle technology? A 1995 Office of Technology Assessment (OTA) report identifies several reasons, including:

- The fuel
- current abundance of the petroleum feedstock
- low historical price for oil worldwide
- substantially higher energy content of gasoline relative to alternatives
- long familiarity of engine designers with gasoline and its properties
- The existing, proven technologies
- performance results in real-world conditions fall short of experimental performance
- low consumer tolerance for features that are not simple or trouble-free
- risk of adverse safety issues (perceived or actual) and of related litigation
- The design process
- duration and the design of any new vehicle
- financial risk of producing a dramatically different vehicle.\(^{66}\)


\(^{64}\) OTA, 1995, p. 228.

\(^{65}\) OTA, 1995, Box 5-1.

\(^{66}\) OTA, 1995, Box 2-1.
Across these issues are a few repeated themes. One is the general lack of consumer demand for alternatives to traditional technologies and fuels. While there is some interest in fuel economy and environmental issues, these do not appear to drive demand greatly when gasoline prices are at all-time lows in the U.S. (in inflation-adjusted dollars).  

Another theme is the known effectiveness of the traditional technologies and fuels. The industry has a century of experience with automobiles based on the internal combustion engine, its power train, and the other familiar characteristics of present-day vehicles. This familiarity means that, slowly and incrementally during these 100 years, performance has been continually improved and manufacturing techniques have steadily lowered costs. Additionally, the manufacturing, fueling, repairing, and other aspects of the infrastructure behind the industry have been geared to work with internal combustion engines. Thus, not only do the existing technologies have the advantage of being proven over time, but there are also major infrastructures devoted to supporting these specific technologies.

A third theme is financial risk. There is risk associated with research and marketing costs, as well as with litigation resulting from perceived or actual safety issues. Furthermore, automakers have some experience with bad publicity that results if any aspects of the product are not as safe, simple, or trouble-free as the consumer has grown to expect.

67 In 1998, gasoline was its cheapest (in inflation-adjusted dollars) since the 1950s. Dunn, 1998, p. 221.
68 The technical innovations needed for the revolutionary improvements in cost and performance required to achieve PNGV goals (as discussed later in this report) thus present remarkable challenges.
69 Problems with airbags, for example, have motivated some drivers to disconnect them.
Consequently, the introduction of new technologies into the automotive industry faces tremendous barriers because of the maturity of the existing technologies and infrastructure, as well as potential risks associated with the introduction of new technologies.

**Convergence and Tension across the Issues**

Looking at these trends over time, one starts to see a pattern across automotive issues and policies regarding such matters as safety, the environment, and energy consumption. In each case, the process starts as the public and/or the government recognizes a problem area. Initial policies aim for the greatest effects with the fewest difficulties (either technically or politically). As time passes, the problem persists or the focus is shifted to some other problem that still remains. Either way, further solutions are sought. At some point, when the easier problems have been solved, only the harder ones remain. Or, perhaps more importantly, societal needs are a function of perception. It is natural that as some progress is made on one problem, the focus automatically shifts to another.

At the same time, as policy-makers tinker with various policy levers, their solutions may affect other aspects of the industry or of society in general. In some cases, the problems themselves are related, such as pollution reduction and fuel efficiency. In other cases, the solutions have side effects in other areas. One example stated previously is the use of CAFE standards, which may result in diminished safety by encouraging lighter vehicles. Another is the promotion of the automobile and highways, despite increasing problems of traffic congestion. Yet another is the use of traffic signals on
freeway on-ramps to moderate congestion, despite the increased emissions resulting from the faster acceleration required on shortened on-ramps.

Figure 2-1 displays federal regulations and initiatives mentioned previously along timelines associated with several types of issues. Circles on the timelines indicate significant federal policies relevant to PNGV, mentioned in prior tables. Dashed lines between the issues indicate policies that have affected multiple categories.

One result of the regulation- and mandate-driven policies towards the auto industry through the 1980s was the creation of an antagonistic relationship between the government and the industry. This relationship provided a general barrier to further negotiations and regulation. As an example, historian John Rae described industry reactions to 1960 anti-pollution laws in California in the following way. “The overall response of the motor vehicle industry regretfully followed a pattern that applied to every major public issue affecting the industry during approximately the twenty years from 1955 to 1975. First, industry spokesmen denied the problem existed; then they conceded
it existed but had no solution; finally, they conceded that it could be solved but that the solutions would be very expensive, difficult to apply, and would require a long time to develop.”

From the perspective of the industry, automakers have faced ever-tightening regulations. Standards and regulations targeted to individual issues create additional burdens and inconsistencies across policies, as noted previously. As one PNGV participant noted in an interview, “All these regulatory approaches impact each other. Safety, emissions controls, CAFE. They’re all moving targets.” The fact that these standards and regulations are issued by several distinct executive agencies plus Congress could only make matters worse.

To summarize, individual policies designed for one problem at a time have been unable to meet ever-rising demands. Furthermore, they have increasingly interfered with one another. Meanwhile, the overall dynamic between government and industry was hardly cooperative, and any negotiations were considered suspiciously by the entrenched adversaries. The time was ripe to try a new type of solution and a new way of interacting between government and industry.

A Shifting Policy Context

While regulators and auto manufacturers continued their feud, the 1980s saw increasing attention to industrial competitiveness and other national priorities. These shifting priorities, combined with increasing evidence of limitations of the technology

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70 Gordon, 1991, p. 14. Specific to PNGV, some critics contend that the Big Three have gone along with it simply to avoid further CAFE increases and/or CARB and other mandates on the sale of ULEV’s, ZEVs, etc. (Dunn, 1998, pp. 178-80).
“spin off” model, started to suggest other potential ways for government and industry to interact in research and development. Concerns for foreign competition, discussed previously in this chapter, prompted federal policies and legislation that would relax prior bans on cooperative industry research. New ideas for interaction were developed, which would eventually result in legislative changes that would permit new options for policy and cooperation. Table 2-6 highlights these enabling laws.

Table 2-6: Legislation That Enabled Partnerships

<table>
<thead>
<tr>
<th>Year</th>
<th>Legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>The Stevenson-Wydler Technology Innovation Act</td>
</tr>
<tr>
<td>1982</td>
<td>University and Small Business Patent Procedure Act (Bayh-Dole Act)</td>
</tr>
<tr>
<td>1982</td>
<td>Small Business Innovation Development Act</td>
</tr>
<tr>
<td>1984</td>
<td>National Cooperative Research Act</td>
</tr>
<tr>
<td>1986</td>
<td>Federal Technology Transfer Act</td>
</tr>
<tr>
<td>1988</td>
<td>Omnibus Trade and Competitiveness Act</td>
</tr>
<tr>
<td>1989</td>
<td>National Competitiveness Technology Transfer Act</td>
</tr>
<tr>
<td>1992</td>
<td>Small Business Technology Transfer Act</td>
</tr>
</tbody>
</table>

Starting with the Stevenson-Wydler Technology Innovation Act of 1980 (Stevenson-Wydler), Congress enacted a series of legislative measures that would increase the effectiveness of federal R&D investments. Stevenson-Wydler added the mission of technology transfer to the commercial sector. The University and Small Business Patent Procedure Act (Bayh-Dole Act) introduced negotiable patenting and licensing of patents for some federal contractors. The Small Business Innovation Development Act of 1982 established the Small Business Innovative Research (SBIR) program, which would provide a means of providing federal funding to small businesses for targeted research. The 1984 National Cooperative Research Act provided companies

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71 Interview with industry manager D, near Detroit, Mich., December 15, 1999 (name withheld on request).
with new options for coordinating their research efforts, some of which had been prohibited previously due to anti-trust concerns. The Federal Technology Transfer Act of 1986 authorized cooperative research and development agreements (CRADAs) between federal labs and private firms and state governments.

Also during this period, Congress enacted the Omnibus Trade and Competitiveness Act of 1988, creating the Advanced Technology Program (ATP) and the Manufacturing Extension Partnership (MEP). The National Competitiveness Technology Transfer Act added government-owned, contractor-operated facilities to the class of “federal labs,” which permitted increased cooperation with the private sector. These programs were intended to provide a mechanism for providing federal investment in critical long-term R&D potentially linked to strategic industrial competitiveness issues and to address traditional commercial under-investment in long-term R&D.

Thus, for a variety of reasons, a number of laws were passed throughout the 1980s that enabled new modes of cooperation among government and industry.

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74 ATP and MEP are programs that have been run by the National Institute of Standards and Technology (NIST) at the Department of Commerce. ATP provided funding support for research in high-risk technologies until the program ended in 2007 (www.atp.nist.gov; website last visited October 2, 2009). MEP provides small and medium sized manufacturers with assistance through a network of regional centers (www.mep.nist.gov; website last visited October 2, 2009).
CHAPTER 3: PNGV DESIGN AND IMPLEMENTATION

By the early 1990s there were several widely shared public goals that together became motivation for a broad, new federal initiative:

- making the domestic automobile industry more competitive globally
- fostering a more advanced domestic manufacturing industry
- improving vehicle efficiency and/or reducing pollution
- reducing reliance on foreign oil
- improving balance-of-trade deficits
- departing from the regulatory approach that had characterized the government-industry relationship in previous decades.¹

This list is not unlike the list of automotive issues presented previously, except that in the past government policies had addressed these goals independently. Of particular interest to this report is the final motivation: a departure from the way in which the government and industry have interacted in the past. The enabling laws of the 1980s permitted a new option to address these issues in a more coordinated way: a government-industry partnership.

This chapter discusses PNGV’s creation, design, and implementation, concluding with a discussion of how PNGV compared to other partnerships of its time.

Creation of the Partnership

In the 1992 elections, presidential candidate Bill Clinton repeatedly stated his intentions to build closer ties between the government and industries.² Around the same

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time, Big Three chief executive officers were complaining that other countries did a better job at maintaining a cooperative atmosphere between the government and the auto industry, and the auto industry’s Motor Vehicle Manufacturers Association was attacking Mr. Clinton for his proposals to increase CAFE standards to 45 mpg.³

Late in 1992, General Motors and Chrysler officials met with Governor Clinton and were surprised to find him to be flexible on the CAFE standards, viewing them as a “goal” rather than a mandate. Upon his election, the Big Three approached President Clinton with alternatives to increasing CAFE. Shortly after the inauguration, his newly selected science advisor Dr. Jack Gibbons approached the Big Three with a proposal to move forward with a partnership. Industry accepted.

In February, the Clinton administration revealed its plans for the auto industry in “Technology for America’s Economic Growth: A New Direction to Build Economic Strength.” The document outlined the goal to reestablish the “technological leadership and competitiveness of the US automobile industry through a major new program to help the industry develop critical new technology that can all but eliminate the environmental hazards of automobile use and operate from domestically produced fuels and facilitate the development of a new generation of automobiles.”⁴ Initially, this effort was referred to as the Clean Car Initiative. Early negotiations between the White House and automotive industry centered on the nature of the fuel efficiency goals. Specifically, the administration was looking to achieve equivalent of three times the fuel efficiency of typical mid-size vehicles, while the industry was resistant to goals beyond twice the fuel efficiency.

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³ Buntin, 1997a, pp. 4-5.
efficiency. Ultimately, the Big Three agreed to the “three times” target, though they succeeded in changing the phrase to “up to three times.”

The automakers had been hesitant to go beyond doubling the fuel efficiency because they were not sure they could achieve it. Vice President Gore felt that going beyond what the Big Three could achieve themselves was the point of the Partnership. The cooperative approach would be justifiable, and the result would be significant. Furthermore, the goal would require revolutionary shifts in technology. Internal combustion engines on steel or aluminum frames would not be able to achieve the 80-mpg requirement.

The Partnership for a New Generation of Vehicles was formally announced on September 29, 1993. Comparing the technical challenge to that of the Apollo space program, the White House announced the objective of strengthening U.S. competitiveness while creating vehicles with dramatically improved fuel efficiency.

PNGV Design

This section summarizes the approach defined for PNGV at the outset, including its goals, structure, funding approach, and intended schedule. A subsequent section of this chapter discusses how this design worked in reality.

PNGV Goals

PNGV had three explicit goals:

- Significantly improve national competitiveness in manufacturing by exploring technologies that reduce the time and cost to design and manufacture vehicles. Improve the productivity of the U.S. manufacturing base by significantly upgrading U.S. manufacturing technology, including the adoption of agile and flexible manufacturing and the reduction of cost and lead times, while reducing the environmental impact and/or improving product quality.
• Apply innovations, when they are commercially viable, to conventional vehicles. Pursue technology advances that can lead to improvements in the fuel efficiency and reductions in the emissions of standard vehicle designs, while pursuing advances to maintain safety performance. Research will focus on technologies that reduce the demand for energy from the engine and drive train. Throughout the research program, the industry has pledged to apply those commercially viable technologies resulting from this research that would be expected to significantly increase vehicle fuel efficiency and improve emissions.

• Develop a vehicle with up to three times the fuel economy of today's conventional, mid-sized sedans, while achieving improved recyclability and maintaining comparable performance, utility, safety and cost of ownership. Increase vehicle fuel efficiency to up to three times that of the average 1994 Concord/Taurus/Lumina automobiles with equivalent cost of ownership adjusted for economics.  

PNGV Technologies

The technical developments targeted by PNGV emphasized alternative approaches to onboard energy production, storage, and use. In order to maximize fuel efficiency, PNGV teams also sought materials and processes to reduce weight. Box 3-1 provides a brief description of some of the promising technologies and materials that had been considered. PNGV’s approach in addressing its many motivations was to focus on development of technologies and materials such as these, rather than traditional regulatory mechanisms.

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### Box 3-1: Glossary of Technical Terms for PNGV

<table>
<thead>
<tr>
<th>TECHNOLOGIES FOR ENERGY STORAGE AND PROPULSION</th>
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<tbody>
<tr>
<td><strong>Advanced batteries</strong> have high rate of energy storage and delivery, and improved energy storage capacity, power, life span, weight, and cost.</td>
</tr>
<tr>
<td><strong>Flywheels</strong> are mechanical spinning devices that store and deliver energy at high rates, with low friction and safe containment.</td>
</tr>
<tr>
<td><strong>Ultracapacitors</strong> are advanced forms of capacitors, which store energy by allowing a charge to build up between two conductive plates separated by an insulator.</td>
</tr>
<tr>
<td><strong>Advanced catalysts</strong> accelerate chemical reactions in more efficient, lean-burn engines.</td>
</tr>
<tr>
<td><strong>Compressed natural gas</strong> (CNG) is a lower cost, efficient-burning fuel with cleaner tailpipe emissions, which can reduce smog-forming potential by up to 60 percent.</td>
</tr>
<tr>
<td><strong>Fuel cells</strong> are systems in which a fuel reacts with oxygen to produce electricity, providing the potential for low vehicle emissions and a diverse fuel supply.</td>
</tr>
<tr>
<td><strong>Gas turbines</strong> are small internal combustion engines that operate at a high rate of speed.</td>
</tr>
<tr>
<td><strong>Hybrid electric vehicles</strong> (HEVs) typically have a combination of power sources, permitting improved emissions and potentially improved fuel efficiency.</td>
</tr>
<tr>
<td><strong>Hydrogen</strong> as a fuel provides the potential for extremely low emissions.</td>
</tr>
<tr>
<td><strong>Regenerative braking</strong> requires a motor and an advanced energy storage device to capture and later supply this energy when needed.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>MATERIALS FOR WEIGHT REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aluminum</strong> alloys are light, strong, and corrosion resistant.</td>
</tr>
<tr>
<td><strong>Titanium</strong> alloys are strong and resistant to corrosion and heat, but are costly to use or recycle.</td>
</tr>
<tr>
<td><strong>Magnesium</strong> alloys are light, easily shaped, can withstand high stresses, but are costly.</td>
</tr>
<tr>
<td><strong>Polymer composites</strong> (including materials such as kevlar, graphite, epoxy, carbon fiber and fiberglass) are costly but very lightweight, strong, and easily molded into complex shapes.</td>
</tr>
</tbody>
</table>

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PNGV Participants

To address its goals, the Partnership was structured to include government and industry members, with additional participation of industrial suppliers, universities, and others. Figure 3-1 is a simple representation of how these components fit together in the Partnership. Chapter 10 provides more information on how some of these components interacted through the Partnership, and how some of those interactions improved because of the Partnership.

Figure 3-1: The Structure of PNGV

PNGV Management consisted of several levels. The Partnership was managed strategically through its Operational Steering Group. Technical and project management was provided by the Technical Task Force, which was directed by the Operational Steering Group. Both bodies were composed of members from government and industry.

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Government Agencies were meant to include the Department of Commerce (DOC), the Department of Energy (DOE), the Department of the Interior (DOI), the Department of Transportation (DOT), the Environmental Protection Agency (EPA), the National Science Foundation (NSF), the Department of Defense (DOD), and the National Aeronautics and Space Administration (NASA). The role of the government agencies was to provide industry with their ongoing research in new technologies, manufacturing processes, and systems design software and methods. This report generally refers to federal labs interchangeably with government participants, though many labs—including DOE’s national laboratories—are themselves contractors to the government.

The United States Council for Automotive Research (USCAR) was and is an organization that houses the various consortia and other cooperative efforts of the automotive industry. It was formed by the Big Three in 1992 to provide a setting for the coordination of joint projects.

The Big Three were the primary original equipment manufacturers (OEMs) in the Partnership: General Motors Corporation, Ford Motor Company, and Chrysler Corporation (or DaimlerChrysler starting in 1998). The role of the manufacturers in the Partnership was to provide resources and capabilities to achieve the goals, in part through the mechanism of USCAR. The Partnership was designed around the largest domestic OEMs to advance the competitiveness of the domestic automotive industry specifically.

Technical Teams and Consortia were created as needed, to provide a formalized setting for the technical interaction among OEMs and between industry and government.

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8 Ultimately, formal participation of agencies such as DOD and NASA was limited due to concerns for straying from activities they are legally authorized to conduct.
As the Partnership was designed, the technical leadership was left to these organizations (and not to government direction, as might have been the case). They played the greatest role in defining the technical plan for achieving the PNGV goals, and they were ultimately responsible for the technical progress.

**Suppliers**, a significant portion of the automotive industry, provide components and assemblies to the auto manufacturers. PNGV included some foreign suppliers that interacted with the domestic automakers.

**Universities** were represented in PNGV primarily through their ongoing research interactions for and with government agencies and labs.

**Other Participants** included organizations that made technical or advisory contributions to the Partnership not otherwise described above.

It is particularly important to note that some parts of industry were not included as participants in the Partnership, including most notably foreign and niche-market OEMs.¹⁰

Fuel sources and utility companies represent another type of stakeholder that was not directly represented in PNGV. The petroleum industry would have a lot at stake if the internal combustion engine were to be replaced or dramatically redesigned. Providers of potential fuel alternatives such as electricity and natural gas also watched the Partnership closely.

Similarly, labor and other industry interests were represented in PNGV only indirectly through the American Automobile Manufacturers’ Association (AAMA) and the United Auto Workers’ Union (UAW), for example.

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⁹ The multinational nature of automotive firms and the continuing mergers, acquisitions, and divestments of many of the automotive OEMs raises questions of what it means to be a “domestic” firm.
¹⁰ Some independent OEMs participated in PNGV via roles as suppliers to the Big Three.
The PNGV Funding Approach

Funding for PNGV was not to be provided through a formal budget at any one agency; instead funding would, according to the PNGV Program Plan, flow through a large array of "contracts, subcontracts, understandings, and cooperative research and development agreements as well as shared research arrangements."\(^\text{11}\) That is, PNGV’s federal "budget" would comprise a collection of separately funded efforts that would be coordinated to work toward the PNGV objectives. PNGV is generally said to have started with a budget of about $300 million per year, though accounting this would prove difficult, as discussed later in this chapter.

The PNGV Program Plan continued, "While the relative proportions of government and private funding will vary depending on the initiative and on the specific project involved, the general rule is that there will be significant cost sharing by industry and government." In general, costs were to be split evenly between government and industry, but the government paid a larger share of the costs of longer-term or riskier research, and industry participants absorbed most of the production costs in the later stages of the Partnership.

The PNGV Schedule

The third major PNGV goal was for the partners to build a prototype high-efficiency vehicle by the year 2004. To that end, the government and industry participants adopted the timeline presented in Figure 3-2.

\(^{11}\) PNGV, 1995, p. 9-1.
The process began with an emphasis on the consideration of components, subsystems and systems analysis. Candidate technologies were assessed for their relative promise in achieving the goals of PNGV by 2004. In 1997, efforts were intended to become more focused, as the partners would identify the most promising candidate technologies (through the so-called “downselect”) and teams would start to design integrated systems of components.

These activities would culminate in the interim goal of concept demonstration vehicles by the year 2000. Concept vehicles help evaluate the engineering feasibility of incorporating potential technologies into total vehicle systems, to yield drivable vehicles that could demonstrate technical capabilities.

The final phase would strive for the final production prototype vehicles to be completed by 2004. The purpose of production prototypes is to demonstrate the performance of the functional attributes of the prototype vehicles, as well as
manufacturing feasibility. In general, production prototypes are highly representative of finished products and production methods, though some details of the manufacturing processes and production design can change prior to vehicle production. The prototyping efforts include detailed designs of how specific systems fit and work together, specialized tooling and fabrication for the specific requirements of these vehicles, and extensive validation and testing of integrated subsystems.

The plan called for design and production of prototype vehicles by each of the Big Three separately, since prototyping requires the full application of technical processes and equipment that tend to be proprietary. 13

The rest of this chapter discusses how the Partnership progressed against this timeline through the end of the Clinton administration, and Chapter 11 reviews PNGV and subsequent policy efforts in more recent years.

An Operational Partnership

So far this discussion has summarized how PNGV was designed to function. Now we discuss what happened during the initiative and note where things did not work as planned.

Funding for PNGV

In assessing the progress of the Partnership, we focus first on funding, as it is an input to any effort that enables and constrains its performance. For the most part, PNGV received no new money beyond the levels that DOE and other agencies already had been 12 From PNGV, 1995, p.7-1.
spending on comparable automotive technology R&D prior to PNGV. In addition, more than once the base funding at DOE was threatened in the appropriations process. Figure 3-3 provides a history of PNGV’s federal funding from 1995 to 2000.

![Figure 3-3: PNGV Federal Funding Estimates](image)

Accounting for PNGV spending was problematic. On the government side, the lack of a central PNGV budget meant that estimates from each participating agency were compiled to arrive at the aggregate funding total. In order to make those estimates, the government had to decide how and whether to account for R&D activities that were

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13 According to a study by the Office of Technology Assessment, the development of production prototypes in general costs hundreds of millions of dollars (OTA, 1995, p. 226). Though beyond the scope of PNGV itself, moving from prototypes to actual production generally costs billions of dollars more.

14 OMB data were compiled from *Budget of the United States Government* volumes from fiscal year 1997 through fiscal year 2001; GAO data are from the U.S. General Accounting Office, *Cooperative Research: Results of U.S.-Industry Partnership to Develop a New Generation of Vehicles*, (GAO/RCED-00-81), March 2000, p. 13.
related thematically to PNGV but were not planned and coordinated by the PNGV directorate. Figure 3-3 shows that OMB and GAO accounting for PNGV funding did not agree completely, for reasons that are not clear.

On the industry side, there were similar questions of which activities each company should count towards PNGV, given that the Big Three had different mixes of proprietary R&D that was relevant to PNGV goals. Industry PNGV accounting was also an issue when it came to some of the cost-sharing requirements that came with federal funds.

Regarding the industry funding levels, in a 2000 review of the program by the National Research Council (NRC), the PNGV task force identified a total estimate of $982 million in 1999 by the Big Three for “PNGV-related” research, with comparable levels for the previous three years. NRC noted that this level of funding far exceeded a 50-50 cost share.

These issues of fair accounting of government and industry expenditures eventually led to a formal role for staff from the White House Office of Management and Budget in acting as Chief Financial Officer for PNGV.

Goal 3: Technical Progress and Outcomes

As discussed in Chapter 5, the Department of Commerce assigned regular external reviews of the PNGV program to the National Research Council. These so-

15 Personal observation from PNGV participation.
16 Personal observation from PNGV participation.
17 NRC, Review of the Research Program of the Partnership for a New Generation of Vehicles, Sixth Report, Washington: National Academy Press, 2000, p. 9. This series of NRC reviews is discussed in more detail in Chapter 5 and the next section of this chapter.
called PNGV Peer Reviews assessed PNGV management and resource allocation and monitored the progress of PNGV toward achieving its formal, technical goals. As the technical outcomes of PNGV are part of what NRC tracked and are not the primary topic of this dissertation, the following section uses excerpts from these NRC reports to chronicle PNGV’s progress toward the 80-mpg production prototypes.

The third NRC Peer Review in 1997 summarized the terms under which PNGV could claim success for its Goal 3 objectives: “The ultimate proof [PNGV’s adequacy and balance] will be embodied in the timeliness of the 1997 technology downselect, the content and level of the performance achieved by the 2000 concept demonstration vehicles, and the performance and cost projections of 2004 production prototypes.”

With that in mind, this summary reviews how things progressed through these three phases.

The second NRC report had expressed concern that management structures and actions were not strong enough on the part of government or industry. It also had raised concerns for the availability of “adequate resources” and their timely and focused use in overcoming the technical barriers that lay in PNGV’s path toward its goal of 80-mpg production prototypes. Overall, it had underscored the magnitude of the challenge: "Despite progress, there is still a wide gulf between the current status of major vehicle

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systems and subsystems and the performance and cost requirements necessary to meet major PNGV milestones."

A year later, in the third NRC Peer Review, little had changed:

Despite significant progress in a number of critical areas, there continues to be a wide gulf between the current status of system and subsystem development and the performance and cost requirements necessary to meet major PNGV milestones. Some of the technical barriers to achieving PNGV objectives can probably be overcome with sufficient funding and management attention; others require inventions and very significant technical breakthroughs.

To address these challenges, the NRC suggested that problems with funding and other resources would have to be improved to achieve success:

The PNGV is experiencing severe funding and resource allocation problems that will preclude the program from achieving its objectives on its present schedule if they are not resolved expeditiously. In the absence of an acceptable and sustained resolution to this PNGV-wide problem in both government and industry, the PNGV’s current objectives will no longer be tenable with respect to performance, cost, and schedule.

The following year included the technology downselect on schedule. At the beginning of 1998, PNGV announced the outcomes of its selection process, saying it would “focus its research and technology development efforts in four key system areas: hybrid-electric vehicle drive, direct-injection engines, fuel cells, and lightweight materials.”

With a successful downselect, the NRC’s tone became more optimistic: “The PNGV has reached its milestone for the initial technology selection process on schedule...


22 NRC, 1996, p. 16.
23 NRC, 1997, p. 3.
The committee notes and commends this progress, which is an important step toward meeting the demanding PNGV goals and schedule.”

The NRC still had concerns for available resources, but they were upbeat on progress: “In the committee’s opinion, in spite of a shortfall in resources in many areas, good progress has been made in assessing the potential of each candidate system and identifying critical technologies necessary to make each system viable.”

The following year brought the 1999 NRC report, and with it a more positive assessment:

In the past year, more progress was made towards meeting PNGV goals than in previous years of the program. In the view of the committee, much of this progress can be attributed to the attitude and efforts of the PNGV technical teams, which appear to be working more cooperatively towards meeting common goals than in past years. The committee considers this to be a very positive change that has provided a needed boost to continuing technical productivity.

Similarly, the NRC said, “For the most part, the PNGV’s efforts during the past year towards meeting its long-term and short-term objectives have been appropriate and have resulted in very significant achievements.”

Even on the question of resources, the NRC reviewers were somewhat more optimistic:

The committee is encouraged this time, however, by several trends. First, the number of technologies was winnowed down during the technology selection process at the end of 1997, allowing PNGV to better focus available resources. Second, the fiscal year 1999 budget for DOE’s Office of Advanced Automotive Technologies provided moderate increases for the development of some long-range technologies, like fuel cells. However, these amounts are still far below the level needed to meet the challenges on a timely basis. Third, the three USCAR

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29 NRC, 1999, p. 4.
partners have substantially increased their proprietary efforts towards the development of concept vehicles, and impressive vehicle-development teams have been formed by each car company. Finally, the PNGV technical teams appear to be working well together.\textsuperscript{30}

They had reason to be hopeful, but again they were concerned that the program would ultimately need more resources than it was getting: “Despite these positive developments, the committee believes the PNGV program will need additional resources.”\textsuperscript{31}

With the year 2000 came the unveiling of the PNGV concept cars at the Detroit Auto Show.\textsuperscript{32} As the NRC later noted, “The year 2000 concept-vehicle milestone was met when the three manufacturers each introduced concept cars: the DaimlerChrysler ESX3, the Ford Prodigy, and the General Motors Precept, as detailed in the last committee report.”\textsuperscript{33}

With these announcements came more congratulations from the NRC:

Considering the magnitude of the challenges facing the program, PNGV is making good progress. As the program has evolved, the PNGV technical teams have become more effective and have developed good working relationships. In addition, the USCAR partners have created substantial vehicle engineering teams devoted to the development of the concept vehicles, which were unveiled in January and February 2000... In general, the committee congratulates the PNGV partners on their progress in the past year.\textsuperscript{34}

However, the NRC’s assessment still had some concerns: “In spite of substantial accomplishments in virtually every technical area of the PNGV program, formidable barriers remain to be overcome. The realization of an advanced high fuel economy

\textsuperscript{30} NRC, 1999, pp. 8-9.
\textsuperscript{31} NRC, 1999, pp. 8-9.
\textsuperscript{32} The author had the opportunity to see the concept vehicles at a PNGV-related workshop in 2000.
\textsuperscript{34} NRC, 2000, p. 2.
vehicle that meets Goal 3 requirements and is acceptable in the marketplace still faces significant barriers of cost, emissions, and fuel infrastructure.”  

The seventh and final NRC review of PNGV came in 2001. This report noted the overall sense of what PNGV had accomplished technically:

The PNGV program has overcome many challenges and has forged a useful and productive partnership of industry and government participants. In addition to the cooperative program, substantial proprietary industry R&D activity has been generated. Teams of industry and government representatives have addressed formidable technical issues and made significant progress on many of them despite the complexity of managing an inter-disciplinary program involving three competing companies, several government agencies, and significant government budget constraints. The program concept cars introduced in January and February of 2000 are important evidence of these activities, but the ongoing R&D program … is equally significant.

However, despite PNGV’s technical successes, the NRC maintained its concerns that the final milestone would not be fully achievable:

“As noted, significant progress continues to be made by the research being performed in the PNGV partnership and in the many proprietary programs being carried out by the individual partners in USCAR. Nevertheless, the committee believes it is unlikely that all of the elements of Goal 3, including three-times fuel economy, will be met in production-prototype vehicles in 2004. While the bulk of the requirements (e.g., performance, comfort, cargo space, utility, and safety) can be met, the combination of 80 mpg and affordability appears out of reach.”

Indeed, by this time the difficulty of achieving the PNGV goals affordably was being raised by various sources, including PNGV partners. As discussed in Chapter 11, at the beginning of 2002, the Bush administration announced FreedomCAR, which replaced PNGV and ended the pursuit of the 80-mpg production prototypes.

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35 NRC, 2000, pp. 5-6.
36 NRC, 2001a, p. 2.
37 NRC, 2001a, p. 6.
Goals 1 and 2: Technical Progress and Outcomes

The history above deals only with the 80-mpg production prototypes called for in PNGV’s third goal. How did PNGV fare towards Goals 1 and 2? In 2000, NRC summarized some of the progress PNGV made towards Goal 2:

Although most of the discussion in this report about achievements and barriers is focused on Goal 3, continuing and significant progress has also been made toward achieving goals 1 and 2. For example, a project has been successfully completed demonstrating continuous cast sheets of Series 5000 aluminum for body structures, and a follow-up project to develop similar processes for exterior body parts is under way. Several smaller efforts to expand aluminum manufacturing and assembly capabilities are in progress, and an alliance between the automotive and aluminum industries has been formed to address standardization, scrap recovery, and other issues. Cost reductions, improved properties, and new manufacturing techniques for carbon-fiber composites, as well as the recycling and design of hybrid material bodies, have also been achieved. Aluminum springback predictability techniques have also been developed.\footnote{NRC, 2000, p. 3.}

The following year, in its final report on PNGV, NRC noted

The most striking Goal 2 achievement is the announced plans by all three automobile companies to introduce hybrid power trains during the next two to three years in both pickup trucks and sport utility vehicles in a variety of configurations. The reduction in fuel consumption will range from 10 to 30 percent, twice the amount that would be saved if the same percentage reduction were obtained by applying hybrid technology to a mid-size car that initially had two times the fuel economy (mpg) of these trucks. The committee commends the automobile companies for this commitment to produce vehicles that will significantly reduce the total fuel consumption of the light-duty vehicle fleet even with an increase in sales.\footnote{NRC, 2000, p. 3.}

Clearly, NRC found reason to praise PNGV’s progress toward Goal 2 in particular.

However, beyond these examples, most sources found it difficult to assign specific technical advances for a particular OEM to PNGV. In fact, the 1996 \textit{PNGV Technical Accomplishments} document describes its contents as “a sample of many recent significant accomplishments in a large number of diverse and challenging technical fields
related to PNGV goals.\textsuperscript{39} Even this government document could not definitively state (or perhaps could not get the industry partners to agree) whether the accomplishments it noted were the result of PNGV.

PNGV Goal 1 proved even more difficult to assess, and perhaps competitiveness was more of a motivating objective for PNGV than a measurable output. In the end, NRC simply said, “...the changed global structure of the industry has made it much more difficult to make sense of the U.S. competitiveness statement in Goal 1.”\textsuperscript{41}

The Shifting Market Landscape

Part of PNGV’s story has to do with what else was happening in and related to the automotive history during the 1990s. One brief account of this history was provided in a 2001 \textit{Automotive News} article: “In the early 1990s, when the partnership was conceived, the Taurus-sided sedan was the primary family vehicle. That’s no longer true. Families buy minivans, four-door pickups and seven-seat sport-utilities. If that is what consumers want, that is where the technology should go.”\textsuperscript{42}

Looking at the numbers, in 1992, cars made up 67\% of the market for passenger vehicles. By the end of PNGV in 2002, cars had declined to 52\% of the market. In that same period, SUVs climbed from 8\% of the market to 26\%.\textsuperscript{43}

\begin{itemize}
\item \textsuperscript{39} NRC, 2001a, pp. 2-3.
\item \textsuperscript{40} PNGV, 1996a.
\item \textsuperscript{41} NRC, 2001a, pp. 10-11.
\item \textsuperscript{42} “Bush was right to save and refocus PNGV,” \textit{Automotive News}, April 16, 2001, p. 12.
\end{itemize}
Why was this? It is often said that SUVs increased in popularity as gas prices fell. As shown in Figure 3-4, nominal gas prices may have been in a modest decline through about 1998, but this effect was less in inflation-adjusted terms.

Figure 3-4: U.S. Average Retail Gasoline Prices

Perhaps the demand for SUVs increased for less rational reasons. Or perhaps a sustained period without significant increases in gas prices allowed the demand for SUVs to build. Regardless, as cars declined in the face of growing SUV demand, the demand for family cars appears to have been affected in particular.

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Regrettably, PNGV had focused on family sedans as a way to make the PNGV prototypes relevant to what the average car buyer wants, which perhaps reflects an assumption that small, fuel-efficient cars were not going to start dominating the market for cars in the near future. While attempting to set a practical goal, the focus on the family sedan inadvertently set its most noteworthy goal to a class of cars that was to steadily lose demand to SUVs.

In the meantime, U.S. sales of hybrid electric vehicles such as the Toyota Prius went from a few thousands to hundreds of thousands within a handful of years. By focusing on a near-term marketable vehicle rather than a more ambitious technical goal, the hybrids of Honda and Toyota would have a greater, more direct impact on the market for alternative vehicles than the direct products of PNGV. Chapter 11 makes a few more observations on the success of Prius and the extent to which it relates to PNGV.

By the end, NRC was calling for the government to revisit its PNGV goals. In 1998 NRC recommended: “The PNGV should assess the implications of the growing vehicle population of light trucks in the U.S. market in terms of overall fuel economy, emissions, and safety. Wherever possible, the PNGV should develop strategies for transferring technical advances to light trucks.”

In its final PNGV report in 2001, NRC again noted the change in market dynamics, but this time recommended more specifically that the PNGV goals be reconsidered:

[The] demand for sport utility vehicles, vans, and pickup trucks in the United States has drastically increased to the point that they now make up 46 percent of

new light-duty vehicle sales. This has increased the importance of reducing the fuel consumption of these vehicles compared to that of the typical family sedan… In view of these facts and as a new energy policy is being developed for the nation, it is the committee’s belief that the priorities and specific goals of the PNGV program should be reexamined. There is a need to update the program goals and technical targets in the context of current and prospective markets.47

The 2001 NRC report continued: “Taking into consideration the successes, degree of progress, and lessons learned in the PNGV program to date, government and industry participants should refine the PNGV charter and goals to better reflect current societal needs and the ability of a cooperative, precompetitive R&D program to address these needs successfully.”48

**Was PNGV Different from Other Partnerships?**

PNGV was not the first partnership between government and industry to develop new technologies. Even before the beginnings of PNGV, partnerships were already appearing in various shapes and sizes in several industries. Perhaps the best known example is SEMATECH, a partnership created in 1987 among semiconductor manufacturers and the Defense Advanced Research Projects Agency (DARPA) at the Department of Defense. As discussed in Chapter 2, such efforts were made possible in recent decades with the passage of federal legislation that removed legal barriers to corporate collaboration in research, which had been in place due to antitrust concerns.

Nor was PNGV the first cooperative research effort between the government and the U.S. automotive industry. Examples of prior collaborations include consortia in composite materials, vehicle recycling, and other programs that, just prior to PNGV, involved individual OEMs with DOE or another federal agency in isolation. Perhaps

47 NRC, 2001a, pp. 10-11.
most notable among the formal consortia developed before PNGV was the 1991 creation of the United States Advanced Battery Consortium (USABC). In fact, not only did USABC and other consortia precede PNGV, but their preexistence facilitated its conception and implementation.

The challenge in identifying comparable partnerships is that efforts that have been labeled “partnerships” comprise a wide array of cooperative efforts with many different purposes, mechanisms, and participants. For the purposes of this dissertation, the particular type of cooperation most relevant to PNGV is the government-industry R&D partnership. The Council on Competitiveness defines such partnerships as “cooperative arrangements engaging companies, universities, and government agencies and laboratories in varying combinations to pool resources in pursuit of a shared R&D objective.” Table 3-1 provides examples of government-industry R&D partnerships fitting this description, through the creation of PNGV itself.

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48 NRC, 2001a, p. 11.
49 Council on Competitiveness, 1996, p. 3.
50 This table emphasizes U.S.-only and federal partnerships. There may be more international and state-level efforts that are relevant at some level, but they were not our focus. This discussion may also have a bias towards multi-agency partnerships.
Table 3-1: Examples of Past/Ongoing Cooperative Efforts, as of 1993

<table>
<thead>
<tr>
<th>Name</th>
<th>From</th>
<th>Membership Industry, Other</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastics Recycling Foundation</td>
<td>1985</td>
<td>EPA, NSF, states manufacturers, users</td>
<td>Improve recycling; anticipate regulations⁵¹</td>
</tr>
<tr>
<td>Clean Coal Technology Program</td>
<td>1986</td>
<td>DOE many companies</td>
<td>Develop technologies⁵²</td>
</tr>
<tr>
<td>SEMATECH Consortium</td>
<td>1987</td>
<td>DOD 14 companies, varies</td>
<td>Increase competitiveness⁵³</td>
</tr>
<tr>
<td>Automotive Composites Consortium</td>
<td>1988</td>
<td>DOE Big Three</td>
<td>Develop light-weight materials⁵⁴</td>
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<tr>
<td>International Cooperative for Ozone Layer Protection</td>
<td>1989</td>
<td>EPA, DOD mixed</td>
<td>Share information; develop solutions⁵⁵</td>
</tr>
<tr>
<td>Specialty Metals Processing Consortium</td>
<td>1990</td>
<td>DOE 9 companies</td>
<td>Reduce defects⁵⁶</td>
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<tr>
<td>U.S. Advanced Battery Consortium</td>
<td>1991</td>
<td>DOE Big Three, EPRI</td>
<td>Develop advanced batteries⁵⁷</td>
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<tr>
<td>Remediation Technologies Development Forum</td>
<td>1992</td>
<td>17 agencies</td>
<td>Identify technologies, regulatory barriers⁵⁸</td>
</tr>
<tr>
<td>Consortium for Plant Biotechnology Research</td>
<td>1993</td>
<td>USDA, DOE, states</td>
<td>Develop drugs, energy sources, etc.⁵⁹</td>
</tr>
<tr>
<td>American Textile Partnership (AMTEX)</td>
<td>1993</td>
<td>DOE, others</td>
<td>Support research; competitiveness⁵⁰</td>
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<tr>
<td>U.S. Display Consortium</td>
<td>1993</td>
<td>DOD 115 suppliers,</td>
<td>Manufacture displays⁵¹</td>
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<tr>
<td>Nat’l. Center for Advanced Information Components Mfg.</td>
<td>1993</td>
<td>DOD, DOE</td>
<td>Speed time to market⁵²</td>
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<tr>
<td>Partnership for a New Generation of Vehicles (PNGV)</td>
<td>1993</td>
<td>DOC, DOE others</td>
<td>Increase competitiveness, energy efficiency⁵³</td>
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</tbody>
</table>


⁵⁷ USCAR, 2005.


Several aspects of PNGV demonstrate its uniqueness among partnerships of that time and, in the larger sense, its significance as a potential model for government-industry R&D partnerships (which is a topic of Chapter 11). Table 3-2 charts the partnerships shown in Table 3-1, now with respect to the following categories: Goals, Outputs, and Organization. These were categorized and labeled based on characteristics apparent from an array of admittedly uneven source material. The category Goals identifies the extent to which the partnerships each addressed certain categories of goals:

- Industry   industrial competitiveness or other measure of strength
- Environment pollution, global warming, waste, etc.
- Energy environment energy generation/conservation, may overlap with
- Safety   reduction of physical or health risks
- Defense   national security
- Discovery scientific discovery

The Outputs category is meant to characterize the types of outputs that are generated to meet the goals of each effort:

- Product creation of products (including prototypes)
- Process creation/improvement of processes
- Science scientific discovery
- Other other improvements, including industry standards, legal mechanisms, etc.

Finally, the Organization columns convey whether multiple agencies and foreign companies participated in each instance.
Table 3-2: Characteristics of Cooperative Efforts Through 1993

<table>
<thead>
<tr>
<th>Name</th>
<th>Industry</th>
<th>Environment</th>
<th>Energy</th>
<th>Safety</th>
<th>Defense</th>
<th>Discovery</th>
<th>Product</th>
<th>Process</th>
<th>Science</th>
<th>Other</th>
<th>Multi-agency</th>
<th>International</th>
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<tr>
<td>Plastics Recycling Foundation</td>
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<td>United States Display Consortium</td>
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<td>Partnership for a New Generation of Vehicles</td>
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Key: • match, • partial match, N no match by design

Table 3-1 shows how PNGV stood out from other efforts by virtue of its goals and structure. Regarding the goals, it is obvious from Table 3-2 that PNGV broke new ground in the breadth of its goals. No effort before it attempted cooperation in so many areas. As noted previously, the multiple factors motivating PNGV tied into many of the nation’s priorities of that time. Such motivations as competitiveness, energy security, the environment, and balance of trade, however, were not necessarily consistent in the actions they might suggest independently, making the Partnership a unique, complex effort.

In fact, PNGV goals arose from factors motivating not just the federal government but other stakeholders as well. The goals were negotiated between the

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64 Categorization was based on information provided in references noted with Table 3-1.
government and industry to capture the many priorities of the federal government and the domestic automotive industry.

The uniqueness of the structure of PNGV is found in its membership and in the way the research was conducted and managed. With respect to membership, PNGV was designed to include the coordinated efforts of several federal agencies with the OEMs. The involvement of multiple agencies was noteworthy in itself. A 1995 report from the Office of Technology Assessment observed that federal R&D efforts in automotive technologies from the 1970s into the 1990s suffered from agency parochialism, but PNGV allowed greater interagency coordination.65 Similarly, the industry side comprised multiple partners in the Big Three domestic OEMs.

To summarize, how did PNGV compare to other partnerships before it? Clearly, few were attempting to accomplish so much. In structure and objectives, PNGV showed the greatest similarity to SEMATECH.66 However, PNGV departed from the SEMATECH model in the structure of the government side, in the research contributions of the government, and in the overall scope of the effort.

The automotive industry consortia that were begun before PNGV do not approach PNGV’s scope or scale. Of course, some of the goals, participants, and funding mechanisms were the same, but these efforts were much more focused on particular technical challenges.

66 Indeed, these similarities are no coincidence. The February 1993 White House publication comments: “SEMATECH ... can serve as a model for federal consortia funded to advance other critical technologies.” Of the possibilities listed, first in the list are: "Programs ... in the development of a new automobile." (The White House, 1993a.)
Together, the goals, structure, and funding of the Partnership made it a new and unique category of government-industry cooperation and coordination.
CHAPTER 4: THEORY RELATED TO AUTOMOTIVE POLICY AND PNGV

The preceding chapters introduce the Partnership for a New Generation of Vehicles and discuss its historical context. Taking a step back, this chapter discusses the theoretical underpinnings of government policies that affect the automotive industry and of the implementation of PNGV as policy.

The chapter first provides some background discussion on markets and market externalities that motivate public policy intervention. The discussion then turns more specifically to the theoretical basis for policies intended to change some aspect of the automotive market and industry, starting with those factors that affect the decisions that producers and consumers make in the market, and how those decisions do not necessarily factor in the larger societal effects of the production and use of automobiles. The chapter concludes with an analysis of the theoretical market effects of possible government policies to promote alternative automobile technologies using simple economic models.

Markets and Externalities

Often government policy in a market strives to motivate a behavior or condition that market forces alone do not motivate. The basis for most models of market behavior lies in the interaction between the supply of goods or services and the demand for them. The production or use of a good, however, often affects society in ways that go beyond the interaction between consumer and producer. For example, in an unregulated market the local pollution arising from the production of the good or the regional or global pollution arising from its use may not be factored into the choices of producers or consumers. Market forces alone do not internalize such effects into the process of
arriving at the quantities or prices of the goods produced. Economists call these side-effects market *externalities*, and policy makers often try to modulate the extent of their effects through the use of public policy.

Negative externalities such as pollution affect society in an undesirable or harmful way. Positive externalities are also possible, such as the larger benefits corporate research can create beyond the benefits the corporation itself will enjoy.

For those reasons policy makers sometimes shift some of the burden of the societal costs of negative externalities onto the producers of a product through taxes and other means. Similarly policy makers may, through subsidies or other support, try to motivate production that has positive externalities beyond levels producers would otherwise be motivated to create. Appropriate policy responses result from understanding who captures the benefits and who bears the costs of decisions that producers and consumers make. For example, while the purchase of a vehicle is a contract between a consumer and producer, the emissions characteristics can affect local communities or regions; the generation of electricity or hydrogen needed to power some alternative vehicles may affect more distant regions; and safety characteristics can affect passengers and other drivers and pedestrians on the road. These and other factors are discussed below.

**Automotive Externalities and Motivations for Government Policies**

The automotive industry has its fair share of such externalities. Indeed, Chapter 2 summarizes some of the societal effects of the automotive industry, as well as the regulations and other policies that have attempted to mitigate or manage them. The chapter notes such factors as pollution, fuel use, and challenges to economic
competitiveness. In each instance, the body of regulations and other policies target some aspect of social welfare that market forces alone do not capture.

Vehicle-Related Pollution

In an unregulated market for conventional automobiles, one form of market externality is in the effect it has on the environment. In the case of the automobile this is a significant factor. Data from the Environmental Protection Agency shows that road vehicles were the greatest source (37 percent) of total air pollutants from controllable emissions in the United States in 1990.¹ Producers generally do not factor the full societal effects of pollution and other environmental effects into their production decisions, nor do consumers do so in their purchases. While smog and other effects of pollution are apparent to each member of society, the individual consumer is only partly motivated to adjust his or her purchases accordingly. Beyond the local effects of pollution, there are also regional and global effects that may have even less effect on individual consumer choice, as they are apparent only in larger aggregates.

At the local level, cars emit gases and particles that have a range of different effects on the environment and public health. Through use and fueling, cars emit hydrocarbons and nitrogen oxides, which react together with sunlight to make ozone, which is connected to respiratory problems. Hydrocarbons can also be toxic, with some links to cancer especially associated with diesel particulates.² Incomplete combustion yields carbon monoxide, which reduces the flow of oxygen in the bloodstream. Metal

¹ Except where otherwise noted, this source of the pollution statistics in this section is: EPA, Automobile Emissions: An Overview, (EPA 400-F-92-007), August 1994, pp. 2-3.
and mineral particulates from automobiles include asbestos, precious metals from catalytic converters, and lead. \(^3\) Local automotive pollution is compounded in dense urban areas, due to the increased concentration of cars, gas stations, more stop and go traffic, and conditions that trap pollutants and prevent their dispersal.

Automotive-related pollution may also have regional effects. Sulfur dioxide and nitrogen oxides from automobile production and use contribute to acid rain. Ozone concentration from emitted hydrocarbons and nitrogen oxides may have effects on regional health and agriculture.\(^4\) Point sources of emissions such as car manufacturing plants, fuel refineries, generating plants (relevant to electric vehicles), and sites where old vehicles are disassembled or stored may be located far from where the cars are driven, and yet emissions in their regions may be significant.

Finally, carbon dioxide emitted by either vehicles or power plants works at a global level to trap the earth’s heat and contribute to potential global climate perturbations.

The numerous gases and particles in these emissions have distinct effects on local and regional air quality, public health, and natural ecosystems. Different types of vehicle technologies generate different combinations of pollutants through their distinct modes of energy generation and storage and fuel consumption. While all vehicles have some forms of these pollutants, new technologies raise new problems and unknowns.

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\(^3\) Freund and Martin, 1993, p. 30.
\(^4\) Freund and Martin, 1993, p. 28.
Use of Fossil Fuels

In an unregulated market for conventional automobiles, another form of market externality has to do with securing the fuels that the automobiles use. As fossil fuels are a limited resource that is not readily renewed, there is pressure to conserve them. Scarce or not, the production and distribution of fuel has costs to society that are not necessarily represented in the price to the consumer. In addition to the environmental costs of the combustion of fossil fuels, fuel stocks and international availability are further considered to be strategic security issues.5

The energy crises of the 1970s demonstrated that consumers can demand fuel efficiency – particularly when motivated by high fuel prices or limitations on fuel availability. Producers also respond not only to satisfy consumer demand for higher efficiency cars, but also to maintain good public relations as “green” companies.

Reducing the need for fossil fuels could be achieved in several ways, including:

- Drivers opting to reduce the amount of driving they do (policies can be in conjunction with public transit options or long-term urban planning alternatives);
- Consumers opting to purchase more efficient vehicles (includes incremental improvements in vehicle design and propulsion efficiency); and
- Consumers opting to purchase vehicles using alternative fuels.

Differences in local and global effects of technologies are meaningful in evaluating distributional effects of policies. For example, a society that used only electric vehicles would still create pollution in generating electricity, though the pollution may be around coal plants instead of in urban areas. Also, certain technologies may reduce one

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5 Indeed, some accounts of the societal costs of driving even factor in the costs of energy security (e.g., MacKenzie et al., 1992).
form of emissions, while increasing others. For example, diesel-based technologies may create fewer greenhouse gases, but at the cost of greater particulate matter.6

Challenges to Economic Competitiveness

Another factor that motivates government policy is competitiveness, either of a given industry or the economy writ large. Maintaining the health of a strong domestic industry, such as the auto industry, is often seen as a worthy goal in itself for several reasons. First, a byproduct of industry is the research performed and the innovation that results, which may have positive effects in other industries and the general economy. Second, large global industries significantly affect international trade surpluses and deficits. Third, these industries often provide significant employment domestically.

The points above have to do with strengthening existing industries. To the extent a new industry might emerge in alternative automotive technologies, policies could help domestic firms gain an early advantage in that emerging industry niche. An early advantage can translate into various benefits, including early growth in manufacturing capabilities that can bring vehicles to market sooner and/or provide higher profit margins. Getting to market sooner may help associate these technologies with a particular manufacturer, which can help it reinforce its identity as a technological leader. There is also the hope that new investment and interest in a new, alternative technology can lead to process and other improvements that bring down costs or add capabilities to conventional vehicles or their production, or lead to more or better jobs in an emerging industry niche.

6 Argonne National Laboratory, Transportation Technology R&D Center, “Particulate Studies -
Some quotations from the early years of the Partnership highlight competitiveness as one motivation for PNGV. For example, Vice President Al Gore announced: “[PNGV is] an act of patriotism but also an act of good business sense, because I predict this will result in breakthroughs that are likely to position our American auto industry to dominate the growing world market in the next century.”\(^7\) Similarly, Mary Good, then Under Secretary of Commerce for Technology, noted that “the need to develop U.S. technology in new products to stimulate exports and create high-paying jobs” was a motivating factor for the Partnership.\(^8\)

On the industry side, another source paraphrases USCAR executive director Don Walkowicz in saying that “whoever comes up with a vehicle that gets 80 miles per gallon will dominate the auto market of the 21st century. If Japan gets there first, he says, it could lead to a repeat of the 1970s, when smaller, fuel-efficient Japanese cars pushed American gas-guzzlers aside, devastating the U.S. auto industry.”\(^9\)

**Modeling Automotive Markets**

So far, this chapter has discussed motivations for policy in broad terms. This section illustrates the theoretical effects of various market policies using microeconomic diagrams of the automotive market. As is the case any time models are used, these diagrams reflect simplifying assumptions in order to convey a primary effect clearly without becoming needlessly detailed.

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\(^8\) Miles Moore, “Partnership seeks development of ‘clean car’: Fuel economy would triple that of today’s vehicles without increasing operating costs,” *Tire Business*, May 2, 1994, p. 6.

A Representational Model of the Market for Conventional Vehicles

In order to understand the effect of policies and market alternatives, it helps to first define a model for a market for conventional automobiles. Figure 4-1 provides a simple economic diagram to represent a market for conventional automobiles. In this market diagram, the supply curve (labeled “S”) represents the minimum prices (shown on the “P” axis) at which producers would be willing to sell a given quantity (the “Q” axis) of their products, assuming no differentiation among the vehicles produced. Meanwhile, the demand curve (labeled “D”) represents the prices at which producers can find consumers willing to pay at a given quantity. Note that there is a small number of consumers (at low quantities) who would be willing to pay high prices. At the intersection of these curves we find the equilibrium price (shown as p*) and the equilibrium quantity (shown as q*) at which the market clears – the maximum quantity produced that satisfies both curves.10 As the supply curve indicates that some producers would be willing to sell some quantities of vehicles at lower prices than this equilibrium price p*, the area to the left of the supply curve up to the price at which the vehicles are sold is considered “producer surplus” (shown in the figure as the shaded area PS).

10 Most introductory microeconomics texts provide details of market supply and demand. For example, see Walter Nicholson, Microeconomic Theory: Basic Principles and Extensions, Mason, Ohio: Southwestern Publishing, 2004.
Figure 4-1: A Simple Representation of the Market for Conventional Vehicles

Clearly, if the demand for a product increases for some reason (and curve D shifts to the right), producer surplus will increase. However, if the curve S shifts to the left (due, for example, to increased production costs), producer surplus will decrease, as will the equilibrium quantity.

This model assumes a competitive market, which is not completely realistic for automobiles. One significant simplification in this model is the competitive market structure itself, where individual suppliers have little power to set prices. Another simplification is to suggest that the various OEMs all make undifferentiated products that have equal levels of consumer demand. Clearly, that’s not the case in real life, where producers go to great lengths to differentiate their products. The homogeneous assumption is still valuable though, as it allows a chart that is relatively easy to understand.
A Representational Model of the Market for Alternative Vehicles

Now consider a parallel market for vehicles with alternative technologies. These alternative vehicles have fewer negative externalities than conventional vehicles do, as they use less fuel, generate fewer tailpipe emissions, and may generate fewer emissions overall.

However, as the model shows, costs of producing cars with alternative technologies are greater than the costs of producing conventional cars, for a few reasons. It is generally more costly to create new products with fewer externalities; otherwise, producers would already have been drawn to those other products as less expensive to produce. In 2005 the Alliance of Automobile Manufacturers (the domestic industry’s trade association) stated on its website: “Any new technology is initially more expensive than the technology it has been designed to replace. Costs will remain high until consumers buy advanced technology vehicles in quantities large enough to bring costs down.”

This is due to the use of new, advanced technologies and materials, as well as the need to introduce new production techniques into a manufacturing infrastructure that has become highly efficient in producing conventional vehicles.

Figure 4-2 shows two parallel markets. The market to the left is the market for conventional vehicles, which is the base case of the market introduced in Figure 4-1. In this diagram, the new subscript “C” associated with the various parameters shown denotes “conventional” vehicles. The second market, shown on the right, is the market for vehicles with alternative technologies, which has an associated supply curve $S_A$ (in which the subscript “A” denotes the market for “alternative” vehicles). To capture our

cost assumption, the supply curve for the alternative market is higher than that of the conventional market. That is, for a given number of vehicles produced, the suppliers will require a higher price to address their increased production costs. For now, we assume the consumer does not distinguish between conventional and alternative vehicles, so the markets share the same demand curve and the equilibrium price for alternative vehicles \((p_A^*)\) cannot exceed the equilibrium price for conventional vehicles \((p_C^*)\).

Note that Figure 4-2 shows the entire supply curve for the alternative vehicle market to be above the equilibrium price established in the conventional market. With such high costs, the model would suggest that no alternative vehicles would be produced, as they would be produced at a loss. Hence, for the alternative market an equilibrium quantity \((q_A^*)\) is not shown. While there are reasons a real OEM might produce some parts of a larger vehicle fleet at a loss (discussed later in this chapter), in this simplified case no rational producer would produce these vehicles. Whether or not this is strictly
true in the actual world, showing the curve this way initially helps clarify and accentuate the effects of certain policies discussed below.

Note that the shape of the supply curve for the alternative market is different in two ways. First, the slope is negative at small quantities, due to the particularly high costs associated with the first vehicles produced with alternative technologies. Second, while this supply curve is shown higher than the supply curve for the conventional market, its slope is not as great, to account for learning effects in an emerging market as production increases.

Of course, in the real world there is overlap in the consumers in these two markets, as well as the suppliers. These diagrams separate consumers with a demand for alternative vehicles from those who demand conventional vehicles, where in reality most of the vehicle-driving population would not fit exclusively into either category. A more realistic model would also show how emerging sales in the alternative-vehicle market affects demand in the conventional market, and vice-versa, especially since the same manufacturers are involved in many cases and these could be modeled as substitute goods. It also would be more realistic to aggregate the supply curves together as a single market for heterogeneous goods, but that would complicate the simple supply and demand curves that this analysis uses to compare the effects of various policy options in the rest of this chapter.

Now that we have a simple model to work with, we will consider the effects of certain types of policies upon the markets it represents. Later this discussion considers the simplifying assumptions this model makes, as well as some of its inherent limitations.
The Effects of Federal Automotive Policies

While many detailed mechanisms exist that can help to modify the choices producers and consumers make, this section uses a simple but representative set of policies to illustrate the effects different types of policy tools can have on a market such as this, and to suggest ways in which combinations of policies might support one another. These models should be interpreted as showing the types and direction of various effects, but neither the magnitudes nor even the relative magnitudes of the effects.

Policies Based on Vehicle-Purchase Incentives Can Enable Sales in the Alternative Market

The government often provides financial incentives or subsidies on consumption for purchases of certain goods, including for example income tax credits for the purchase of hybrid-electric vehicles.\textsuperscript{12} To reflect this in our supply and demand model, we assume that consumers in the alternative market will be willing to pay the equilibrium price for vehicles from the conventional market ($p_C^*$), plus the amount of the incentive ($i_A$), for a new price $p_A^*'.  Consumers still pay out of pocket the conventional price $p_C^*$, but since producers are willing to provide vehicles at that price, the market clears at the fully subsidized equilibrium price $p_A^*$.  At this new equilibrium, the model shows the alternative market now can yield a producer surplus on production (the shaded area $PS_A'$).\textsuperscript{13}

\textsuperscript{12} Taxpayers pay the costs of government incentives such as these.
\textsuperscript{13} From the perspective of producers, consumer behavior is the same as if the demand curve shifted out to intersect the point at which $S_A$ meets price $p_A^*$. 
However, keep in mind that if we still assume that consumers are indifferent between conventional and alternative vehicles, the increase in equilibrium price for the alternative market can be no greater than the amount of the incentive. Thus, the alternative vehicle market can clear only with a purchase incentive large enough to meet the price at which the demand and supply curves meet.\(^{14}\)

Recall that our model assumes undifferentiated products with equal levels of consumer demand. If instead we were to permit consumers to differentiate among vehicle traits, the model could also show how the demand curve may be affected directly by factors that increase consumer demand at a given price. Examples include improvements in vehicle performance, luxury qualities, safety, or fuel efficiency, as discussed in the next section. Also, not all demand-incentive policies in the real world are solely based on monetary rewards. For example, some states and localities have

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\(^{14}\) The figure shows a level even greater than this, primarily to highlight that consumer demand would exceed the demand curve shown, simply because the price from the perspective of consumers is still only \(p_C^*\), as they do not pay the incentive portion \((i_A)\) of the full equilibrium price \((p_A^*)\).
policies that permit special driving and preferential parking privileges for electric or hybrid vehicles.

**Policies Based on Fuel Affect Vehicle Use and Vehicle Demand**

Gas taxes are one way to pass societal pollution externalities to the operators of the vehicles. If it costs more to drive, drivers may soon find ways to reduce miles driven (for example, by using public transportation). In addition, if high fuel costs persist, consumers may be motivated to purchase more fuel-efficient vehicles. While in the past this has meant more fuel-efficient conventional vehicles, it can also translate to a market for alternative vehicle technologies, increasing their demand (see diagrams in preceding section).

In addition to policies regarding fuel price, another form of fuel policy can directly target specific technological externalities. Policies on the properties of automotive fuel, for example, can reduce particular types of pollution under some circumstances. If responding to a mandate on fuel content translates to a cost to the fuel supplier, it is likely that suppliers would pass those costs to the driver, which affects the cost to operate the vehicle.

**Policies Based on Vehicle Fuel Consumption Affect Vehicle Supply**

Other types of policy can mandate fuel efficiency across each producer’s line of vehicles. The Corporate Average Fuel Economy (CAFE) standard sets a level for a manufacturer’s fleet-wide mile-per-gallon (MPG) average. For every 0.1 MPG a producer exceeds the standard, there is a penalty multiplied by the vehicles in the fleet. Modeled simply, such a policy imposes a supply disincentive on inefficient vehicles.
Since the standard is on the vehicle fleet, the standard allows some inefficient vehicles, but only if their inefficiencies are balanced by enough efficient vehicles to meet the required fleet average.\textsuperscript{15}

The auto industry has met (or in some cases has tried to meet) the CAFE standards by pushing sales of efficient internal combustion engine-based vehicles. Indeed, an approach of (a) making incremental improvements to the efficiency of conventional vehicles and (b) strategically providing a mix of efficient and less efficient vehicles has enabled OEMs to meet CAFE during periods when the standards do not increase.

The government also may increase pressures to produce alternative vehicles by some means other than fuel efficiency standards. For example, California had a more direct means by requiring in state law that OEMs offer a certain share of zero-emissions vehicles among their fleets for sale or they would face fines.\textsuperscript{16}

If these standards and other regulations increase, they could become so burdensome on the OEMs that the added costs passed on to the price of the conventional vehicles could start making efficient technologies more attractive.

Using the economic models, Figure 4-4 shows how supply disincentives can drive up costs for conventional vehicles, moving the conventional supply curve ($S_C$) inward.

\begin{itemize}
\item\textsuperscript{16} In 1991, the California Air Resources Board (CARB) created the requirement that two percent of all passenger cars offered for sale by manufacturers in any model year must be zero-emitting vehicles. EPA rulemaking and subsequent CARB regulations weakened this mandate. (EPA, “California State Motor Vehicle Pollution Control Standards; Amendments to the California Zero Emission Vehicle (ZEV) Regulation; 2003-2006 Model Years Within the Scope Request; 2007 and Subsequent Model Years Waiver Request; Opportunity for Public Hearing.” As of December 29, 2008: http://www.epa.gov/fedrgstr/EPA-AIR/2005/January/Day-18/a931.htm)
\end{itemize}
This would drive up the equilibrium price (to \( p_{C^*}' \)). With the increase in the conventional equilibrium price, the alternative equilibrium price can also increase to that same level.

The outcome is that conventional producers earn less producer surplus (as the shaded area \( PSC' \) is smaller than the previously shown area of \( PSC \)), while alternative producers can begin to sell vehicles at a producer surplus (\( PSA' \)). In this way, supply disincentives can affect make the alternative market viable and can otherwise reduce the relative producer surplus advantage of the conventional vehicle market.

However, note that there is unsatisfied demand for vehicles in the alternative market, based on the position of the supply curve \( S_A \) at price \( p_{C^*}' \). There is some question on whether this condition would persist in a more realistic model, without all of the simplifying assumptions of this analysis. Perhaps the demand curve might even shift left if consumers adjust their expectations for vehicle supply.
Policies Based on Assisting Technology Development Affect Supply

The Department of Energy funds automotive research in part to help industry develop technologies that could translate to lower costs for the market for alternative vehicles.\textsuperscript{17} This is a common type of motivation for any federally sponsored research that is highly tied to a particular industry. PNGV provided an initiative with specific goals for a production prototype, but it was not unique in supporting research meant to affect an industry.

Figure 4-5 shows how reducing manufacturing costs for alternative technologies can shift the alternative supply curve \((S_A')\) outward, thus translating into another way to yield producer surplus in that market \((PS_A')\). (Note again that there is unsatisfied demand in the market for alternative vehicles.)

\textbf{Figure 4-5: Supporting Technology Development Can Lower Production Costs}

\textsuperscript{17} While some of the technological improvements can also be used in the conventional market, this simplified discussion omits that less direct effect.
Aside from the specific effect on the supply curve shown, this type of policy tool is fundamentally different from the other types of policies discussed above. For the most part, the other market interventions above share two characteristics. First, the tax incentives and other policies that affect demand require continued use of those policies to maintain the effect noted; for example, a one-year tax incentive will affect only those consumer decisions for that year. In contrast technology investment of one or a few years can yield a lasting effect on the supply curve. Second, many types of market interventions cause distortions in the market, ultimately lowering the market’s overall economic efficiency. For example, fees on production or sales of conventional vehicles directly reduce the surplus for both producers and consumers of those vehicles. Further, economic distortions may require continued policy adjustments as they can diminish the natural market processes.

In contrast, while some investment (either federal or private) is needed to improve the technologies in question, the overall effect is to increase the supplier surplus overall while enabling the market for alternative vehicles. Investment can cause its own form of distortion in the market, but does not affect the market mechanism directly. Those responsible for the PNGV approach may not have analyzed the relative benefits of supply- or demand-based policies as laid out in these paragraphs, but the advantages over some of the alternative policies are noteworthy and seem to echo comments such as then Vice President Gore’s, quoted above.

Certainly, an explicit intent of PNGV was to use alternative vehicle technologies to reduce pollution and other negative externalities that aren’t captured in the decisions made in the marketplace. As President Clinton’s first science advisor said of PNGV:
“[Tripling the mileage of a typical car] won’t aid just auto makers… If you look at air pollution, oil imports, [carbon dioxide] emissions, and foreign competition, there’s a long list of public benefits that come from a breakthrough in automotive technology.”

Additional Thoughts on Economic Models

The models presented above show the effects of different policies upon the prices, quantities, and producer surplus that result for the two vehicle markets shown. Several simplifications are built in.

The market diagrams use a model of perfect competition to describe a complex, highly regulated set of markets that involve monopolistic competition, a market in which a small set of producers enjoy some benefits of a monopolistic market due to large barriers to entry.

The assumption that the two markets are shown with identical demand curves also simplifies reality in a few ways. First, the diagram for the conventional market assumes that consumers are indifferent to the wide range of performance, safety, emissions, and other technological factors, as well as less tangible factors such as convenience features and the effects of marketing, brand loyalty, and “snob appeal.”

Second, we assume that consumer demand for conventional and alternative vehicles is similar. In reality, there are many possible configurations of alternative vehicles, and they could have a wide range of performance characteristics, relative to one another and to conventional vehicles. Some studies have suggested that some subset of

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18 John Carey and Mary Beth Regan, “Here Comes the Uncle Sam-Mobile,” Business Week, October 11, 1993, p. 32.
consumers is willing to pay more for “cleaner” vehicles.\textsuperscript{19} This could be shown in the diagrams by shifting outward the demand curve for alternative vehicles. However, performance of alternative vehicles often does not match that of conventional vehicles in all respects. Furthermore, even with the same performance characteristics, new vehicle technologies may necessitate new requirements for driving, fueling, or maintaining the vehicles, adding to expenses or inconveniences borne by the consumer. Additional expense or inconvenience would likely decrease consumer demand.

A third simplification inherent in our demand curve assumptions is that we are modeling these two markets as if they were related by price alone. The markets shown in the diagrams represent a dramatic simplification of the relationships among markets for different models and types of vehicles. Realistically, these markets are interrelated in many ways, and, as previously noted, any change in demand for one type of vehicle would affect the demand of the other vehicles (note that the relative sizes of the markets would also affect the magnitude of the change). Similarly, it is not clear in these models whether the producers in the two markets are the same (and balancing their production decisions across vehicle lines) or distinct competitors.

Of course, a combination of these policy levers can be used together. For example, federal policies such as PNGV coexisted with federal and state demand incentives for alternative vehicles, as well as certain types of supply disincentives for low efficiency vehicles (such as CAFE standards).

A New Approach to Partnerships

The rest of this chapter focuses more directly on the theoretical basis for the approach chosen for PNGV.

Why Form a Partnership?

The preceding sections provide some understanding of the motivations for federal policies that affect the development and production of alternative vehicle technologies and particularly a federal investment in R&D for alternative vehicles. The discussion now turns to the factors that led to the formation of a government-industry partnership as a policy response.

To help understand partnerships, it is useful to consider in a general sense why any organization would choose to cooperate with another. Perhaps the most concisely stated purpose for cooperation may be one the Council on Competitiveness identifies: “leveraging capabilities.” More specific motivations for participants of any cooperative effort include the desires to:

- pool diverse talents and resources,
- share costs,
- spread risks,
- develop cross-partner standards, and
- learn new processes from partner.

Additional motivations exist that are more directly specific to PNGV. For example, one of the motivations and perceived benefits of the Partnership has been the alignment of goals and efforts speeding the study and implementation of promising technologies across the industry.

These reasons exist in different forms and to varying degrees across all cooperative efforts and partnerships. For example, they motivate temporary strategic alliances between companies as well as large-scale government-industry partnerships among dozens or hundreds of participants. Indeed, each of these factors was relevant at the start of PNGV.

One strong motivation was the pooling of diverse talents and resources. The strengths of the government were seen to be the untapped research at the national labs – especially the more fundamental research that the government tends to fund more than industry does. Meanwhile, government cannot match the experience the automakers have in implementing technologies and developing vehicles. In a 1995 article in *Automotive Industries*, Joe Laia from Los Alamos National Laboratory states: “People here are scientists and engineers. They are not in the private sector. It would be incredibly arrogant to think that we would be able to walk in and say you guys (in Detroit) are doing it all wrong.”²¹

Another motivation for industry was that of cost – access to federal R&D findings and resources meant R&D savings for industry. That said, federal R&D expenditures did not directly and immediately eliminate all needed industry R&D costs. Federal R&D often does not pursue technological solutions that industry can readily adopt; generally industry must invest subsequent funding and effort to apply a solution to its particular problem.

Another key motivation for industry was that of risk. A company has limited motivation to spend its investments in areas of great uncertainty or risk. If companies can
cooperate, it helps spread and diffuse the risk across a greater funding base, and federal investment can help further, of course. Henry C. Kelly, the one-time assistant director for technology at the White House Office of Science and Technology Policy (OSTP) noted the need for cooperation for this reason: “It’s too big for anyone to undertake on their own.”

Finally, the Partnership offered a tangible alternative to the adversarial past the industry had experienced in working with federal and other regulators. Tim Adams, the one-time PNGV director from Chrysler, said:

PNGV represents the opportunity to more efficiently address fundamental national objectives than the regulatory mandate approach that we have taken before… We’re going to create market drivers to get people to act in ways consistent with national objectives. That’s instead of distorting the market by forcing people to do things that they really don’t want to do. That’s powerfully attractive.

Further, the industry was aware that the perception that it resisted regulation was not good for its public image. Chairman of the PNGV Task Force Rob Chapman noted: “The industry on its part saw an opportunity to avoid being portrayed as consistently opposing the safety and environmental improvements the government advocated.”

Both government and industry saw potential benefit in cooperation. To summarize various accounts and sources, the automakers recognized possibilities to:

- improve products (cost, weight, performance, safety, quality, demand);
- reduce costs;
- improve their public relations;

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minimize costs of regulations (whether by negotiating around them, guiding them by interacting in their creation, or by improving vehicle characteristics before the improvements are required);
minimize the costs associated with lobbying and lawsuits; and
spread the risk of pre-competitive investment among more participants.

Meanwhile, the government saw the opportunity to:

maximize the benefit of federally funded research;
improve the competitive position of domestic industry;
eventually improve the efficiency of cars in the U.S. (reducing consumption and improving energy security);
in the process, reduce the effect on the environment;
minimize the need for regulations;
minimize unintended effects of regulations; and
minimize the costs of enforcing regulations.

A Summary of Costs and Benefits of PNGV

Table 4-1 summarizes various benefits and costs that PNGV had the potential to address. The table identifies four broad stakeholder groups and shows how they each saw distinct benefits and costs. The domestic auto industry benefited in a few ways, including market factors such as new products and reduced costs, as well as potential regulatory advantages. With these benefits, costs included tangible costs of time and energy in active coordination with government and industry participants as well as less tangible costs of possible loss of profits and other opportunities. Car buyers and drivers could eventually have benefited financially from benefits in fuel efficiency, and if consumers have increased demand for “green” technologies, the Partnership could speed their introduction to market. The U.S. theoretically could have benefited broadly from

25 Note that one report discussed in the next chapter (NRC, Energy Research at DOE: Was It Worth It? Washington: National Academy Press, 2001b) attempted to estimate costs and benefits of PNGV and other DOE R&D programs, primarily from a perspective comparable to the “U.S. Government and Taxpayers” row in Table 4-1. On the balance, the report found that despite the lack of demonstrated benefits to date, the “potential benefits of PNGV measure favorably against the expenditures of DOE since 1993” (p. 151).
more productive use of taxpayer dollars in achieving these benefits (the costs to the U.S. taxpayer base), though it is not clear whether PNGV or other policy tools would have been the most efficient ways to achieve significant outcomes. Finally, the rest of the world could have benefited if the Partnership had significantly increased or sped the production of technologies that pollute less.

Table 4-1: Theoretical Benefits and Costs of PNGV

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Benefits</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Auto Industry</td>
<td>May position partners in new market with new consumer demand</td>
<td>Cooperation increases coordination costs</td>
</tr>
<tr>
<td></td>
<td>Cooperation may mean less time and expense in lobbying regulators</td>
<td>Sharing information could come at expense of proprietary gain</td>
</tr>
<tr>
<td></td>
<td>Forestalls regulation</td>
<td>If cooperation approach fails, effort may divert energy from alternatives</td>
</tr>
<tr>
<td></td>
<td>Reduction in R&amp;D costs</td>
<td>Establishing viability of technologies could result in government mandates</td>
</tr>
<tr>
<td></td>
<td>Increased standardization across OEMs reduces costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Big Three could benefit from &quot;green&quot; associations</td>
<td></td>
</tr>
<tr>
<td>Car Buyers and Drivers</td>
<td>Eventual savings from improvements in fuel efficiency</td>
<td>Possible cost increases as OEMs pass costs of R&amp;D to the consumer (depending on whether PNGV results in more or less corporate R&amp;D funding)</td>
</tr>
<tr>
<td></td>
<td>Some cooperation among OEMs can reduce their costs, which can reduce vehicle costs</td>
<td>Possible cost increases as OEMs pass costs advanced materials to the consumer</td>
</tr>
<tr>
<td></td>
<td>Possible increased consumer demand for &quot;green&quot; technologies</td>
<td></td>
</tr>
<tr>
<td>U.S. Gov’t. and Taxpayers</td>
<td>Focused research may yield greater benefit of taxpayer investment</td>
<td>Direct costs of R&amp;D funding (from taxes or opportunity costs)</td>
</tr>
<tr>
<td></td>
<td>Eventual reduction in need for demand subsidies</td>
<td>Cooperation increases coordination costs</td>
</tr>
<tr>
<td></td>
<td>Cooperation with industry could reduce need to regulate market</td>
<td>Focus on specific PNGV goals could come at the expense of funding for other technology paths</td>
</tr>
<tr>
<td>World</td>
<td>May help reduce regional pollution, global climate change, and other industry externalities</td>
<td>Foreign OEMs excluded from the Partnership</td>
</tr>
<tr>
<td></td>
<td>May advance and help publicize scientific and engineering research</td>
<td></td>
</tr>
</tbody>
</table>

A Departure from Prior Automotive Policy

As discussed in earlier background chapters, in 1993 the incoming Clinton administration felt that traditional automotive policy approaches were failing to provide
solutions for the concerns perceived by our society. Potential threats to the oil supply and concerns for global warming motivated some interest in alternative fuels and technologies, but this level of interest did not itself create a new demand for efficient vehicles. Incremental shifts in emissions regulations held little hope for dramatic technological improvements, given the reluctance of automakers to make costly investments if demand for them was not sure to follow. Individual policies designed for one problem at a time had become unable to meet ever-rising demands, and they increasingly interfered with one another. Making matters worse, the relationship between government and industry was at least as antagonistic as it had ever been. With a new concern for the competitive strength of the U.S. automotive and manufacturing industries in general, federal policy makers were faced with some tough decisions.

The relaxation of anti-trust legislation of the 1980s, motivated in part by the concern for industrial strength, allowed a range of new possibilities for business and government to work with each other. In particular, the cooperative R&D these legislative changes allowed offered an appealing path towards innovative, alternative vehicles, with all their potential advantages. This, all together allowed a new type of policy solution: a new way of interacting between government and industry.

By opting for a partnership, federal and industry participants had the opportunity to reinvent their interactions. PNGV provided a means to address multiple problems simultaneously, and conflicts between goals could be better identified and addressed. While a broad-based policy may not provide the ability to target all issues equally, such a policy has much greater ability to provide a coordinated and perhaps prioritized response to multiple issues. Figure 2-1 from Chapter 2 showed an array of policy issues in which
the automotive industry has been part of; Figure 4-6 illustrates how PNGV’s design could address many of these issues at once.

As these chapters have discussed, PNGV was not motivated by emissions per se, nor was it motivated specifically by energy concerns or competitiveness. Instead, it represented an institutional mechanism for moving away from the way the government and industry had interacted in the past, and provided them instead with an interactive, cooperative means of achieving selected societal goals. In this way PNGV perhaps created a new form of government-industry cooperation and an alternative to traditional regulatory antagonism, potentially relevant not only to the automobile industry but also to other industries. This dissertation sets out to show that, organizationally if not technologically, PNGV provided a new vehicle for change.
CHAPTER 5: PRIOR PNGV RESEARCH AND THIS DISSERTATION

This dissertation is not the first analysis of PNGV. There have been several efforts to review and document aspects of PNGV from various perspectives. Some were written by program insiders, others by formal external reviewers, others by industry analysts, and still others by Congressional offices. Some have focused on PNGV goals and governance, others on technical progress, and others on international comparisons. PNGV has been the sole focus of some studies, and one program among many in other studies.

This chapter characterizes prior assessments of PNGV, noting in particular the scope of these studies. The chapter concludes with a discussion of how this dissertation has a unique scope and place in the PNGV literature.

A Review of the Literature

Repeated searches of the literature identified several reports and books that featured some in-depth assessment of PNGV, which are discussed below. This discussion is limited to studies that assess the Partnership or some aspect of it in a meaningful way. Given that this dissertation focuses only on policy and institutional aspects of the PNGV effort specifically, these pages do not reflect the large body of literature on efforts to develop automotive technologies outside of the Partnership.

The following sections summarize the relevant literature in the context of four basic types of studies: internal accounts, external program reviews, Congressional oversight reports, and other studies. Grouping this discussion in this way helps to
characterize these studies in ways that are clearer and less repetitive than if they were discussed in sequence.

**Internal Accounts of PNGV**

Some studies assessed aspects of PNGV by virtue of the authors’ direct involvement in the Partnership. For example, Donald Hillebrand completed a study in 1996 entitled, "Government-Participant Interactions, Partnership for a New Generation of Vehicles."\(^1\) As a Society of Automotive Engineers (SAE) fellow working for the PNGV Task Force, Hillebrand provided an insider’s view on how the Partnership worked. In his words, his white paper was “intended to be a source document on how this unique and historic Partnership between the government and automobile industry effected technology transfer." It provided an in-depth look at the structure and processes of the Partnership, including his perspectives and recommendations. While this report is a useful reference for the early years of PNGV, it did not analyze how well the Partnership worked, nor did it delve into relationship aspects of the Partnership.

In 1998 Robert Chapman, the original chairman at DOC of the PNGV Technical Task Force, collected his perspectives on the Partnership in *The Machine That Could: PNGV, A Government-Industry Partnership.*\(^2\) Mr. Chapman discussed many aspects of the Partnership, including his personal observations and lessons learned. Mr. Chapman’s observations derived from his unique perspective on the Partnership. He referred to the relationship aspects of PNGV, mostly in the context of challenges with industry partnering with the government, and vice versa. However, otherwise his lessons and
observations largely did not focus on the impact PNGV had on the interrelationships of its partners.

Another description of PNGV from the Clinton administration’s perspective came in the form of a 1998 report from the National Science and Technology Council (NSTC): *Public/Private Partnerships: Implications for Innovation in Transportation.*

NSTC was and is a council of senior agency representatives that provides coordination of science and technology efforts across federal agencies. This report profiled government-industry technology partnerships in a few areas related to transportation, starting with PNGV. The report was semi-analytical, as it provided a framework to compare the partnership examples by four common traits. However, the report did not directly address relationship aspects of the Partnership, beyond briefly noting its potential to be more efficient than regulation and to increase coordination and communication.

Of course, in addition to these three sources, there were other official reports and releases generated directly by the PNGV program, the participating agencies, or USCAR, but those were not studies in the same sense, so they are not listed as part of this review of the literature. Some of these are noted in Chapter 7 and are the source of quotations used to support the analysis of this dissertation.

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2 Chapman, 1998. (Disclosure: I assisted Mr. Chapman’s report while at RAND.)
External Program Reviews

Many federal research programs (and others) use external program reviews to promote impartial assessments by qualified reviewers. There are various organizations that use a variety of approaches to perform such reviews for federal programs, but most if not all comprise individuals who do work outside of the federal government.

One particularly thorough and well-regarded source of PNGV assessment was the periodic formal reviews performed by the National Research Council. The first *Review of the Research Program of the Partnership for a New Generation of Vehicles*\(^5\) was published in 1994, and it was followed by another six follow-on reports each year from 1996 to 2001. These reviews were requested by the Department of Commerce, on behalf of PNGV.

These studies, at times referred to within the Partnership as the “NRC Peer Reviews,” assessed the overall “adequacy and balance” of the Partnership, as well as its management and progress toward it goals. To do so, the NRC standing committee responsible for the review interacted with PNGV officials and participants in meetings, reviews, and site visits. These assessments were highly detailed because the OEMs gave NRC special access to proprietary information on ongoing technical activities. The resulting reports provided findings and recommendations, many of which influenced subsequent federal PNGV management.

The review process met NRC’s typically high standards of review – the reputation of the NRC rests largely on the objectivity and thoroughness of its reviews. As a

personal observation, this peer review process was highly effective. The resulting reports are well-focused and accurate. The reader will note various references within this dissertation to results of these reviews. Relative to this dissertation, however, the NRC assessments focused more on the conduct of the program and its progress toward the three explicit technical goals than on PNGV relationships and other broader impacts.

The President’s Committee of Advisors on Science and Technology (PCAST) was and continues to be an external advisory body for the White House on science and technology issues. In 1997, PCAST published a report *Federal Energy Research and Development for the Challenges of the 21st Century,*\(^6\) which assessed various aspects of federally funded energy R&D efforts. The report provided four specific recommendations for PNGV, including starting a second PNGV-like effort in parallel to focus on longer-term automotive technology solutions. Like others of its kind, this report did not explicitly address relationship aspects of PNGV.

The costs and benefits of DOE R&D in the areas of energy efficiency and fossil energy were the subject of another NRC study in 2001: *Energy Research at DOE: Was It Worth It?*\(^7\) Resulting from direction attached to DOE’s appropriations legislation for fiscal year 2000, NRC studied many of DOE’s applied research programs, including PNGV and related activities, including advanced batteries and fuel cells. The study identified few benefits the program had realized to date, but noted very high potential

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\(^{6}\) Executive Office of the President, President’s Committee of Advisors on Science and Technology (PCAST), Panel on Energy Research and Development, *Report to the President on Federal Energy Research and Development for the Challenges of the 21st Century,* 1997.

\(^{7}\) NRC, 2001b.
benefits.\textsuperscript{8} This study briefly touched on technical benefits of DOE partnerships with industry, such as “joint selection and guidance of a portfolio of projects, including early consideration of marketing issues and the appropriate termination of projects showing inadequate progress toward goals.”\textsuperscript{9} Otherwise, the study did not address relationship aspects of the Partnership.

\textbf{Congressional Oversight Reports and Hearings}

The United States Congress has many ways it can request studies on a particular topic, depending on many factors including the type of study and the urgency of the request.

Among the final documents of the now defunct Congressional Office of Technology Assessment (OTA) was its 1995 report, \textit{Advanced Automotive Technology: Visions of a Super-Efficient Family Car}.\textsuperscript{10} This report analyzed the prospects for developing and commercializing cars in the next 20 years with significant improvements in fuel economy and emissions, so while the report was broader in scope than just PNGV, parts of it were relevant to the PNGV goals. The primary focus of the report was on the technical potential and costs of various alternative technologies. It devoted a late chapter to an international comparison of government automotive policies and capabilities, including discussion of the goals and focus of PNGV.

Another overview of the Partnership was completed in February 1996 by Fred Sissine of the Congressional Research Service (CRS): \textit{The Partnership for a New...}

\textsuperscript{8} NRC, 2001b, pp. 34 and 151.
\textsuperscript{9} NRC, 2001b, pp. 34.
\textsuperscript{10} OTA, 1995.
Generation of Vehicles (PNGV).\textsuperscript{11} This report outlined a number of issues relevant to consideration of the federal role in PNGV, overall funding, and the management structure of the Partnership. Much of the discussion summarized the findings of other assessments, including the first NRC review and the OTA report.

The General Accounting Office completed a study on PNGV in March 2000, in response to a congressional request for information on PNGV’s accomplishments, historical funding levels, and technologies, as well as balance between its publicly and privately funded activities. The study, called \textit{Cooperative Research: Results of U.S.-Industry Partnership to Develop a New Generation of Vehicles}, integrated conclusions of prior assessments of PNGV with conclusions of its own, based on interviews with participants.

Subsequent CRS reports discussed similar aspects of PNGV, including Brent Yacobucci’s report \textit{Advanced Vehicle Technologies: Energy, Environment, and Development Issues}.\textsuperscript{12} In this report Yacobucci summarized the current states of research in alternative vehicle technologies. While PNGV was not itself central to his focus, Yacobucci noted its role in the continuing development of these technologies. Yacobucci also wrote \textit{The Partnership for a New Generation of Vehicles: Status and Issues}, which updated prior CRS reports on PNGV’s progress through the 2002 announcements of FreedomCAR.\textsuperscript{13}

All of these Congressional oversight reports provided status overviews on PNGV efforts with some synthesis of observations and recommendations from other reports. None of these reports focused on the relationship aspects of PNGV.

In addition to these reports there also were Congressional hearings on PNGV goals and progress. PNGV was the subject of the following Congressional hearings:

- “Partnership for a New Generation of Vehicles; the Clean Car Initiative,” May 19, 1994.14 This hearing addressed the goals and initial execution of the Partnership.
- “Partnership for a New Generation of Vehicles (PNGV): Assessment of Program Goals, Activities and Priorities,” July 30, 1996.15 This hearing followed up on the execution and progress of PNGV.
- “The Future of DOE's Automotive Research Programs,” February 7, 2002.16 This hearing explored how FreedomCAR compared with PNGV.

Most hearings provide testimonials from multiple viewpoints, but with only limited synthesis of viewpoints or analysis. None of the testimony on PNGV had as its primary focus the address relationship aspects of the Partnership, but selected quotations from these hearings appear in this dissertation.

Other Studies

The only doctoral dissertation found related to PNGV was C. Beth Fitzsimmons’ thesis at George Mason University: “Knowledge spillovers from joint government-industry-supported research: A case study from the automotive industry.”17 This study

examined spillover effects from government research in the automotive industry, focusing in particular on the flow of technical information and patents from efforts related to PNGV’s cast light metals and rapid tooling efforts. Her dissertation chronicles aspects of the Partnership but does not study relationship and partnering aspects.

Another relevant report was a 1997 case study of the creation of the Partnership, performed by John Buntin of Harvard University’s Kennedy School of Government. Entitled "From Confrontation to Cooperation: How Detroit and Washington Became Partners,"\(^{18}\) the case study chronicled the creation of PNGV, from President Clinton’s election through the first NRC peer review in 1994. A second part of the story, “Rallying Behind PNGV (Epilogue),”\(^{19}\) followed as an update to the original case. Together, these case studies provided an early organizational history for PNGV, with no attempt at analyzing the Program’s likely or actual effectiveness with respect to technologies or relationships.

Another type of assessment was written in 1997 by Melissa Polverini, an intern sponsored by the Society of Automotive Engineers. “International PNGV-Equivalent Programs: Where does the United States stand?”\(^{20}\) was a comparison of PNGV with other programs being pursued in other countries and by foreign OEMs. This study did not address the relationship aspects of these efforts, but Polverini’s survey did touch on the effects some efforts may have had on others, which is an issue that Chapter 11 of this dissertation discusses.

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\(^{18}\) Buntin, 1997a.

\(^{19}\) Buntin, 1997b.

Finally, Daniel Sperling, the director of the Institute of Transportation Studies at the University of California, Davis, authored several assessments of PNGV in journal articles over time. Among these that had a strong PNGV component were:

- 1994: “Gearing Up for Electric Cars,”\(^\text{21}\) which provided recommendations based on initial PNGV implementation;
- 1996: “PNGV: An Unsuccessful Partnership Whose Time Has Passed,”\(^\text{22}\) which emphasized the need to adjust PNGV implementation to be effective;
- 1996: “Rethinking the Car of the Future,”\(^\text{23}\) which echoed many of the themes in his other 1996 article.
- 2001: “R&D Partnerships for the Next Cars”\(^\text{24}\) and “Public-Private Technology R&D Partnerships: Lessons from US Partnership for a New Generation of Vehicles,”\(^\text{25}\) twin studies that explored PNGV’s successes and lessons; and
- 2002: “Updating Automotive Research,”\(^\text{26}\) which looked back at PNGV in the context of the Bush administration’s new FreedomCAR initiative.

Additionally, Sperling testified at the 1996 and 2002 Congressional hearings mentioned above, with testimony covering issues similar to the articles he wrote in those years.

While none of these articles had the issue of PNGV relationships as their central thrust, “Rethinking the Car of the Future” referred in passing to improving the relationship as an overarching objective of both government and industry for partnering. Additionally, Sperling’s studies from 2001 both discuss the idea of PNGV as a model for other partnerships, as well as the idea that PNGV may have had a role in accelerating the


\(^{24}\) Daniel Sperling, “R&D Partnerships for the Next Cars,” *Access* (publication of the University of California Transportation Center), Number 18, Spring 2001, 2001a, pp. 2-9.

technology development efforts of competing OEMs. These concepts and Professor Sperling’s observations are discussed in Chapter 11 of this dissertation. Overall, while Sperling’s articles provided thoughtful assessments and were useful resources for this dissertation, they did not address partner-relationship issues to significant depth.

There are many other reports that referred to PNGV, though to lesser degrees than those noted above. There were also many accounts of PNGV in the press. They are different in flavor from the other types of assessment this chapter identifies, but among the most thorough was a three-part story in Chicago Tribune in 2002, “Supercar: The tanking of an American dream.”

A final body of literature relevant to PNGV had to do with evaluations of government/industry partnerships more broadly. These sources were useful in providing context for PNGV in at the end of Chapter 3.

None of these articles and other types of reports provided a significant body of literature relevant to the sorts of questions this dissertation pursues regarding relationships in PNGV.

**Intended Contributions of This Research**

The intent of this dissertation is to add a missing component to the literature on PNGV: assessing whether PNGV was able to break through adversarial stalemate and find a new way that government and industry, as well as stakeholders within industry, can

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work together toward common goals. That is, did PNGV improve relationships between partners?

In the process, this assessment may introduce new components to assessments of multi-sector R&D partnerships.

The next chapter provides the details of how this dissertation was defined and structured to achieve those ends.
CHAPTER 6: STUDY DESIGN

Research Questions and Hypotheses

A 1996 request from the PNGV Secretariat at the U.S. Department of Commerce prompted this research. Robert Chapman, the first chairman of the government’s PNGV Technical Task Force, saw the need for an independent study of the Partnership, a program assessment that would document how it works and assess its value as a model for federal policy. At the time, this author supported a RAND contract with Mr. Chapman’s office to help identify ongoing federal R&D efforts that could be relevant to PNGV research needs. Mr. Chapman offered to help support a study on PNGV, and the following research questions were proposed:

- What aspects of the Partnership should be the focus of the assessment?
- What type of assessment would be useful?
- What type of assessment would be feasible?

Various types of studies might have fulfilled this need. For example, one could try to compare the program in question to historical or theoretical policy alternatives. As Chapter 2 discusses, PNGV was a policy approach to address many factors resulting from and affecting the market for automobiles, such as emissions, fuel efficiency, and industrial competitiveness, and a great many historical or theoretical policy alternatives could have been used to address the various issues involving PNGV. Addressing all issues in this method would require modeling not only of the effect of PNGV, but also countless combinations of alternative policies that might affect the same factors. Early articles and other documents concerning PNGV demonstrate that there were many

1 For more information on the author’s professional association with PNGV and the Department of Commerce, please refer to the discussion at the end of this chapter.
different opinions of the motivations and potential impact of the Partnership. Some critics appear to focus on its value as environmental policy, others on its value as industrial policy, and still others on its value as trade policy. This seemed both untenable in scope and impossible from the perspective of getting sufficient reliable data for a meaningful assessment.

As a technology partnership, an obvious question is: how well did PNGV meet its goals of developing and implementing new vehicle technologies? Unfortunately, the competitive nature of the auto industry severely limits the availability of data associated with R&D, regardless of whether or not those data are considered proprietary. In general, data on the intermediate technical steps of the Partnership were restricted. This also highlights the particular role of the NRC committee chartered with reviewing the progress of the Partnership. Indeed, the very existence of the NRC role in assessment meant that any additional technical assessment would be unnecessary (and less complete). Thus, measures of the technical success or quantitative effects of the Partnership are not only difficult, but would also offer little added value beyond the NRC Peer Reviews.

Consequently, the technical success of the Partnership is not the focus of this dissertation. Instead of these other approaches to program assessment, this study sets out to explore the subtler, more fundamental accomplishments of the Partnership. As Chapter 2 introduces, in addition to the stated technical goals, PNGV represents a desire for a new way to address various challenges in the interplay between government and industry.
The overarching research question becomes: What institutional changes did PNGV accomplish? Two primary research hypotheses support this question:

- PNGV improved the relationship between government and industry; and
- PNGV increased cooperation within the industry.

What does it mean to “improve a relationship” in this context? The quality of a relationship between organizations might be gauged in various ways, including the nature and frequency of communication, the level of understanding and trust between participants, and the ability to work through differences to achieve their shared goals. This dissertation explores these and other factors that contribute to and result from constructive relationships.

In addition to the primary hypotheses above, this dissertation also provides preliminary investigation of two other hypotheses:

- PNGV was partly responsible for instigating a race among domestic and foreign OEMs to develop alternative technologies; and
- PNGV has been influential as a model for partnerships.

While this study cannot address these latter hypotheses conclusively, it provides some insights on these matters.²

**Research Design**

This dissertation addresses these hypotheses by examining the Partnership as a case study that includes some elements of other methods. In his book *Case Study Research: Design and Methods*, Robert Yin recommends case studies for exploratory research questions that pursue “how” or “why” something functioned or something came

² As Chapter 11 discusses, the evidence necessary to fully address these hypotheses is beyond the scope of this dissertation. A more complete exploration would require more data and analysis on motivations and activities of individuals and organizations outside of the Partnership.
to be. For questions of “what” happened, such as the effects of a given policy, he notes strengths of other methods as well.\(^3\) Using a combination of analytic tools in the framework of a case study is most appropriate to the nature of the hypotheses and also fits the sources of data for PNGV that are most relevant and available.

Yin discusses some common concerns for case study methods. First, some feel case studies lack rigor. He responds that case studies are not unique in that respect, but it is important to take proper steps to avoid bias. The discussion of data in the next section addresses these steps in this dissertation. Second, some note that case studies provide limited ability to generalize. Yin responds that while one cannot use them (or experimental methods) to generalize statistically, one may generalize analytically from case study results. Finally, Yin notes that some feel case studies take too long and yield long, unreadable studies. Yin responds that this complaint has been valid but need not be.\(^4\)

The unit of analysis of this study is the Partnership itself. By this choice, the resulting lessons and conclusions will have implications relevant to subsequent partnerships, both in the auto industry and elsewhere. Certain components of the case study lend themselves to smaller units of analysis (such as individual PNGV technical teams), but those aspects of the research are included to provide the detail for the study of the Partnership as a whole.

Following the case study approach recommended by Yin, an analytical design addresses these hypotheses. The characteristics and goals of PNGV do not lend

\(^3\) Robert K. Yin, *Case Study Research: Design and Methods*, Newbury Park, Calif.: Sage Publications, 1989, pp. 16-20. (Other aspects of case study methods are discussed in greater depth in the next chapter.)

\(^4\) Yin, 1989, p. 21.
themselves to a single data set or quantitative method of analysis. Yin promotes using multiple sources of evidence as a primary principle of data collection for case studies. He suggests that multiple sources provide access to a broader range of historical, attitudinal, and observational issues. In addition, any finding or conclusion in a case study “is more likely to be much more convincing and accurate if it is based on several different sources of information, following a corroboratory mode.” Accordingly, multiple sources of evidence work in conjunction to support the hypotheses of this dissertation.

**Research Scope and Assumptions**

This dissertation explores the effect of PNGV on (a) the relationship between government and the U.S. automotive industry and (b) cooperation and other factors within the automotive industry. The dissertation also highlights evidence of the broader influence of the Partnership, not only on the industry and market for vehicles with alternative technologies, but also as a model for cooperation.

The dissertation does not discuss in depth any of the technological breakthroughs or other societal benefits that came to pass during the Partnership, and does not set out to prove whether or not these breakthroughs or benefits were the sole, direct result of the Partnership. Similarly, the dissertation does not assess the design or effectiveness of PNGV relative to policy alternatives, aside from the policy alternatives Chapter 4 provides for context. Beyond listing potential costs and benefits, the dissertation does not assess the cost-effectiveness of the PNGV approach.

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5 Yin, 1989, p. 97.
The Author’s Role in the Partnership and Objectivity in this Research

In writing this dissertation, the author sought to provide an objective, value-neutral analysis. Evidence and opinions are used that support the hypotheses, of course, but any evidence and opinions that counter the hypotheses was also included. In order to highlight potential biases, when conveying the attitudes and stated opinions of others the text speculates on factors that might motivate the source to provide a positive or negative statement.

To provide full disclosure, the author had a small participatory role in support of PNGV between 1996 and 2000, supporting a RAND contract with the PNGV Secretariat at the U.S. Department of Commerce to help identify ongoing federal R&D efforts that could be relevant to PNGV research needs. To do this, the author worked with RAND’s RaDiUS database, a comprehensive source of information on past and ongoing R&D across all federal agencies. Part of RAND’s contract to support the PNGV Secretariat also helped fund work toward this dissertation, through 2000.

Through subsequent employment for the White House Office of Management and Budget, the author was in part an analyst on R&D issues and programs across the federal agencies. In this role, the author had no oversight of the Departments of Commerce or Energy, PNGV, or the subsequent FreedomCAR Initiative. The author had brief, isolated contacts with some relevant PNGV and FreedomCAR participants, but these contacts were not used in this analysis. To avoid any potential conflicts between employment and the research, the scope of this dissertation was limited to PNGV and did not extend to
study FreedomCAR as a continuation or a contrast to PNGV. The author left the employment of the Office of Management and Budget in 2007.

Participation in the Partnership provided some personal insights to how—and how well—the program was working, but it also could raise questions regarding the author’s objectivity in this analysis. To minimize potential bias, the author went to great lengths to not rely on personal observations in this analysis, as explained in the next chapter, which discusses the data and methods. Among other techniques, external sources are used as much as possible and all views encountered are reflected in the analysis, and not only those that corroborate personal views formed through participation.

Indeed, the next chapter discusses how participant-observation is a valid technique for gathering data for case studies. Indeed, a researcher’s dual role as both participant and observer is not unheard of in institutional analyses, and to the methods used in this study conform to common practices for such studies.

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6 Of course, one will find in this dissertation certain statements of fact regarding the timing and intent of the FreedomCAR program.
This chapter discusses the types of data and methods this dissertation uses to address the hypotheses outlined in the last chapter. The first half of the chapter discusses the types of data that are typical in case studies and the extent to which each of these types is available for use in this dissertation. The second half of the chapter summarizes the methods this dissertation uses in applying the data to the research hypotheses.

Data Sources for Case Studies

Chapter 6 presents the rationale for using a multi-source case study, following an approach recommended by Yin.\(^1\) Yin identifies six general sources of data for case studies: documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts.\(^2\) Documentation includes reports, newspaper articles and editorials, briefings, and other releases. Archival records include databases, budgets, distribution lists, and other incidental data arising from the functioning of the subject of the case study. Interviews are targeted discussions conducted by the researcher with participants in or witnesses of relevant activities. A research can conduct direct observations to gain insights into relevant activities. Participant-observation requires a participating role of the researcher in some aspect of the subject’s activities in order to gain further insights. Finally, physical artifacts are objects used in or resulting from the activities of the subject.

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\(^1\) Yin, 1989.  
\(^2\) Yin, 1989, p. 85. I have paraphrased the descriptions of these data sources.
This study benefited from access to examples of all of these forms of evidence. Of these data sources, three primary types form the backbone of this study: documentation, archival records, and interviews. Direct observations, participant-observation, and physical artifacts play a lesser role in this analysis, having provided guidance for the design of this study and serving to reinforce the primary sources of evidence. The rest of this chapter specifies the types of evidence that fit into these categories, and highlights the benefits and drawbacks of each source of information.

Three characteristics are particularly important in assessing the available data. The data must: (a) be applicable to the research questions, (b) be of sufficient quality to provide a meaningful test of the hypotheses, and (c) be in a practical format, from sources that may be cited in this research. In the course of discussing several sources of evidence, this chapter assesses each source with respect to these three criteria.

First, for applicability, the data must address the research hypotheses and other areas of interest. In this case, the study sets out to measure and document the accomplishments of the Partnership above and beyond its primary three technical goals. The emphasis is on changes in perceptions and interactions among industry participants and between industry and government participants. To that end, the primary arguments require data that address one or more of the following conditions:

- perceptions, attitudes, or interactions among participants before the Partnership,
- perceptions, attitudes, or interactions among participants after the Partnership began,
- inferred or clear attribution of any such changes to the Partnership.

Additionally, other types of evidence that do not entirely meet these conditions may play roles in supporting the primary evidence, or they may address discussions in
this dissertation focused on matters other than the primary hypotheses. For example, we will outline how the Partnership came to be, and what participants have learned in the process.

Second, for quality, the data should come from reliable sources, with as much supporting material as is possible. Data should come from sources that are in positions to provide credible assessment or opinion. Ideally, the evidence includes at least some named sources who may be deemed objective by virtue of their position relative to the Partnership, and whose statements address the hypotheses in a clear way. Sources of opinion associated with advocacy positions may be used, but should be used carefully, due to inherent bias. Yet such opinions can be especially persuasive, particularly when they make statements conceding some factor that could work against their advocacy position. The section below outlines potential biases associated with various data sources on a case-by-case basis.

Finally, with respect to practicality, the data must be usable. Data that are in an awkward format or are overly distilled may be difficult to apply. For example, presentations often use graphics – pie charts or bar graphs – without providing the underlying numeric data. Unless the underlying data are found, the graphics most likely cannot provide enough information to use accurately. The practicality condition also prohibits data that compromise the confidence of interview participants, or that violate the proprietary nature of sensitive, company-specific sources.

Existing Sources of Evidence on PNGV and the Automotive Industry

When applied to a study on PNGV – or a study on the automotive industry in general – the search for data presents several challenges. Of course, the quality and
explanatory power of data relevant to the research questions is an issue in any study. Additionally, specific to this study, finding data on the activities and expenditures of the automotive industry is very difficult.

Ensconced in a competitive industry, automakers do not provide complete data on the focus or magnitude of their R&D efforts. Motivations understandably center on the marketplace, in which a competitive edge is highly dependent on proprietary research, development, and design. Additionally, the automakers may be motivated to keep some activities and capabilities private from federal and state regulators, environmental groups, or the general public. As Lovins and Lovins point out, “…a long and unhappy history of being required to do (or exceed) whatever they admit they can do has left [automakers] understandably bashful about revealing capabilities, especially to Congress… Thus automakers are more likely to understate than to trumpet progress.”

For these reasons, figures on R&D expenditures are available only at aggregate levels and thus are of limited use. This is particularly true given that the expenditures within PNGV for efficient or clean technologies were dwarfed by development costs for individual vehicle models.

Outputs of PNGV-related research are apparent from auto shows and certain interim documents and press releases, but attribution to PNGV was inconsistent. Of the R&D numbers that are shared for the sake of the Partnership, most were considered to be


4 For example, at the 1997 North American Auto Show in Detroit, some felt that mention of PNGV was missing from OEM announcements of fuel cell plans (e.g., Bill Visnic, “Fuel (cells) for thought,” Ward’s Auto World, March 1997, p. 141). In contrast, concept cars unveiled at auto shows in 1999 and 2000 included more prominent acknowledgement of the role of PNGV.
proprietary and only to be used for the sake of satisfying requirements to match funding levels with those of their government partners.\(^5\)

Participating government agencies and other organizations were more forthcoming with some forms of research data, but the utility to this study of the data in question is again an issue. Results of government research can be seen as a product of the Partnership in some ways, particularly to the extent that the research portfolio has been shifted to align better with the priorities of the Partnership. However, in many ways, this federal research was an input to the Partnership, as it was among the resources used by industry to achieve the technical goals of the Partnership. Furthermore, while government organizations are accountable to the public, not all preliminary materials resulting from government research are made public. Indeed, the working relationship between government and industry required government knowledge of some industry R&D data. The government had to respect the sensitivity of such data for the sake of the competitive edge of the participating automakers. Some data from the government side of the Partnership were available from the government management of the Partnership (including components at the Department of Commerce and the White House Office of Science and Technology Policy), the automotive technology efforts at DOE, and elements of the other agencies that contributed to the Partnership.

**Source: Documentation**

Of the types of data Yin discusses for case studies, perhaps the most diverse is documentation. For PNGV, these include four fundamental types of evidence: official

\(^5\) As I discuss in Chapter 8, participants at times questioned the utility and validity of this fund-matching exercise, though there is a consensus that it has to be done at some level.
Partnership publications and press releases; independent participant publications and press releases; assessments of the Partnership and related programs; and articles and opinions from periodicals and other sources. This section discusses the first three of these sources of information, and subsequent sections discuss types of periodical-based evidence and methods for gathering it.

Official published materials of the Partnership include documents released centrally through the White House, the PNGV Task Force, and USCAR. Examples include:6

Press releases from the White House and the PNGV Task Force;

- *Declaration of Intent*, the overview of the Partnership provided at its announcement in September of 1993;7
- *PNGV Program Plan*, a plan for the Partnership that was published by the Department of Commerce in 1995, once the management, funding, and other issues had been formalized;8
- *Inventions Needed for PNGV*, an assessment of key technologies relevant to PNGV, published by USCAR in 1996;9 and
- *PNGV Technical Accomplishments*, a summary of accomplishments as of 1996, published by USCAR.10

In addition to these official, centralized sources, there are also publications and press releases from the individual participants of the Partnership, such as:

- Publications by participating agencies, National Labs, USCAR, OEMs, suppliers, universities;
- Press releases from agencies, labs, USCAR, OEMs;

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6 The Bibliography provides full citations for all sources in this discussion.
8 PNGV, 1995.
10 PNGV, 1996a.
• Newsletters from agencies (e.g., *Pacesetter*, from DOC’s Office of Technology Policy), federal labs, and USCAR (the *Mileposts* quarterly newsletter); and

• Speeches by individuals from various participant organizations and companies.

As discussed in Chapter 5, various external groups performed analyses on aspects of the Partnership. Examples include reviews by the National Research Council, Congressional oversight and assessment organizations (e.g., OTA, CRS, GAO), and independent analysts. Congressional hearings provide another type of review. These sources vary widely in focus and approach. Please refer to the overview of PNGV-related studies in Chapter 5 for more information.

In general, the use of program documentation and other assessment provides a historical record of the announcements on, developments in, and attitudes toward the Partnership. As each publication is associated with a specific time and source, the analytic chapters build a story by interweaving them together. Furthermore, historical sources strengthen arguments made about the past, where interview questions about the past are necessarily limited by potential biases of hindsight.

**Collection Strategy: Literature Reviews**

One class of case study documentation is composed of articles, opinions, and assessments of a program in newspapers and magazines. This form of documentation is worth discussing in greater depth for several reasons: the number of articles in periodicals is so much greater than other forms of documentation, these articles come from a large number of distinct sources with distinct perspectives, these articles provide unique research possibilities, and these articles pose their own problems of bias. Periodicals report on events, summarize official releases, quote participants and industry experts, and sometimes provide opinion on efforts or accomplishments. In addition to reporting on
specific events and accomplishments, these sources can be mined for quotations and commentary, which may provide snapshots of attitudes over time.

This dissertation is based to a large degree on literature reviews used to collect relevant excerpts from books and periodicals through multiple means. A primary goal in data collection was to cast nets wide, hoping to catch a broad set of interesting articles and reviews. Steps were taken to avoid bias through the use or exclusion of specific sources, but otherwise, attention to specific sources was only a secondary concern. This approach included a combination of many online searches, manual reviews, and incidental clippings. A section later in this chapter discusses how these sources were used, including content-analysis over time for some regular sources.

Source: Interviews

In addition to documents by and about the Partnership, original data collection provides another source of information. In principle, this can include formal written surveys, focus groups, and individual interviews, though this dissertation uses only the latter. Yin calls interviews “one of the most important sources of case study information.”

The primary advantage of this source of evidence is that the researcher can design the topics discussed to fit perfectly into the research hypotheses. Additionally, the face-to-face interaction permits the interviewer to notice and correct any misunderstandings of the respondents, to perceive nonverbal clues that could be significant, to probe

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incomplete or vague responses, and to answer questions and reduce concerns about the study itself.\textsuperscript{12}

Aside from their high cost, the disadvantages of interviews center on potential biases that can result from interview methods, which this section discusses in detail. First, in any process of original data collection, some factors affect the sample of individuals that participate in the study. Interviews add more possibilities for bias, due to the reliance on the interaction between interviewer and interviewee, the limitations of human recall, and the possibility that responses may be affected by self-interest. Finally, the interpretation of the tone and meaning of the responses poses further room for bias.

In social science research, there are many factors that can affect the sample of the data that a researcher collects. In interviews or surveys, these factors include: who is sought for participation, which of those individuals can be located, and which of those individuals are available and willing to participate. However, unlike more quantitative social science research methods, the goal of interview data in a case study is generally not a statistical characterization of the data. Thus, while a breadth of the “sample” of individuals interviewed is worth pursuing, it is not necessary for that sample to be formed to statistically represent the population in question. Interviewees were sought who could demonstrate the range of perspectives on the Partnership, without hoping to numerically estimate how common those perspectives are across all participants. Simply the fact that any participant would make certain observations could be highly important. Performing multiple interviews with individuals from certain groups was important to lend strength

to the observations of this dissertation, but opinions that resulted repeatedly provide corroboration rather than statistical strength.

The interaction between interviewer and interviewee can affect the interview results. The interviewee may want to say what they think the interviewer wants to hear. Conversely, the interviewee may not want to provide such an answer if they have a poor reaction to the interviewer. An interviewee may experience distrust or some other reaction to the study itself, to the motivations for or sponsor of the study, or from their expectations of the conclusions of the study. On the other hand, interviewers may have expectations of what a category of respondents will say, which can bias the results. Finally, research has demonstrated that demographic differences between interviewer and interviewee can affect how interviewees answer questions and how interviewers interpret them.\textsuperscript{13}

Individual recollections are central to most interviews, and they provide a particularly strong source of bias, known as hindsight bias. It can be difficult to recall when something happened, who was there, what was said, and one’s feelings at the time. Situations and values from the present often affect one’s perceptions of the past. It is very difficult to guarantee that responses about a prior time are not affected by biases of hindsight. Some types of questions may reduce this potential, but ultimately the reliance on mixed types of evidence may provide the best way of minimizing the effects of such bias. For example, when the analysis focuses on events in the past, interview results may take a back seat to types of evidence that are less affected by hindsight, such as opinions expressed in periodicals from the time in question.

Another type of bias in interviews may result from the self-interest of the respondent. The respondent may be motivated to provide answers that increase or improve some effect relevant to either him or her personally; his or her team or company; or the Partnership as a whole. For example, one might assume that most people involved in the Partnership would want it to be perceived well, and this wish could affect how they characterize it. This is not to say that one would expect interviewees to consciously state falsehoods in their own self interest – this bias generally has more to do with subtle choices of responses, or the way the responses are presented. While this bias may affect few responses, the results were used as if the risk was much greater. Corroboration, especially from distinct types of interviewees, adds credibility by reducing the risk from individual self-interest. Additionally, the analysis most highly values responses that provide opinions that would be counter to the expected self-interest of the interviewee.

**Interview Approach**

Social science research methods include methods for improving the results of data-collection interviews, including ways to reduce the potential for bias. As the remainder of this section discusses, such methods were used to create the interview protocol, perform the interviews, and interpret the results. The following five steps summarize this process:

1. design of the interview approach,
2. creation of the interview protocol,
3. identification of potential interviewees,
4. setting up and performing the interviews, and
5. using the results.
In reality, the steps involved were neither as discrete nor as sequential as this list suggests.

The first step involved thinking through the purposes of performing data-collection interviews. A structured logic was defined to appropriately address the research hypotheses. Every response could not be anticipated, but it was necessary to create questions that would elicit responses relevant to one or more of the hypotheses. Questions were then tailored to the logical chains of evidence crafted to support the hypotheses.

The following sections discuss the subsequent steps in the interview process.

Creation of the Interview Protocol

The interview protocol was prepared with four principles in mind: the need to collect evidence relevant to the research hypotheses, the need for the evidence to meet certain standards, the need to understand the role of each interview participant, and the need to minimize the potentials for bias inherent in interview-based evidence. Together, these principles maximized the value of the interviews and, consequently, of any analysis based on them.

The primary advantage of preparing a formal protocol was to provide uniformity and consistency to the answers that result. Time is always a factor in interviews such as these, and it reinforced the importance of ensuring that the most important questions were asked, whatever happened. The busy schedules of all of the interviewees that participated in the study cannot be overemphasized, and in facilitating a tight interview the protocol maximized the benefit for the limited time spent.
At the same time, the types of individuals from industry and government pursued to participate in the study (discussed below) had unique perspectives and interesting anecdotes. It would have been a mistake to not allow them the flexibility to talk on the subjects with which they were most familiar. Often, the examples they volunteered and the anecdotes they provided were highly informative. And if they have specific complaints or commendations, they could be highly relevant. Thus, it was necessary to find a balance between an overly formal protocol and a more free-flowing interchange.

The evidence collected not only addressed the hypotheses but also was tailored to maximize its utility in related logical arguments, especially since interviews provided an ideal way of receiving information tailored to the particular research interests (unlike statements gathered from periodicals and other documents). Questions were based on a written exploration of the hypotheses, breaking them into sub-hypotheses and forming alternative hypotheses to also consider. To be clear, the act of tailoring the questions to directly address the research hypothesis is different from wording a question to guide the response in a particular direction, which was avoided.

In general, questions in an interview should be stated clearly and directly, to minimize ambiguity in the answers. Accordingly, each question was limited to a single idea or reference to avoid the risk of confusing either the interviewee with the question or the interviewer with the response.

The proper structure of questions depends on the purpose of the question, and, indeed, the protocol used a mix of structures. One aspect of question structure is whether to use open-ended or closed-ended questions.
Open-ended questions allow free response, in a desire to avoid leading the interviewee. Such questions may yield more unique responses from the interviewees, as they must reflect upon their own experiences in order to provide any answers. However, answers to open-ended questions may be subject to what the interviewee is able to think of at the moment. Further, free-form responses may be hard to characterize during analysis, as each will be unique. Finally, the thoroughness and detail of such responses may reflect characteristics of the individual interviewee, such as enthusiasm, intensity, verbosity, etc.

Conversely, closed-ended questions limit responses to a fixed set of alternatives with which the interviewee may agree or disagree. Such responses are easy to code for comparative assessment, and they may provide the interviewee with greater understanding of the purpose of the question. However, it is possible that closed-ended questions may simply provide responses to which the interviewee will agree. Rather than gaining an understanding of the effects the interviewee noticed most, such responses may restrict responses to the options given, or may yield “all of the above” responses in many cases. A final drawback of closed-ended questions is that the quality of the question is dependent on the thoroughness of the expertise of the interviewer – in writing the protocol the interviewer must already be familiar with the range of responses he or she will receive.\(^\text{14}\)

Each type of question has benefits and drawbacks, and indeed, there is a role for each in the course of the interview. One approach is to first ask open-ended questions, to hear the unprompted responses of the interviewees, followed up by closed-ended

questions, which may provide a wider range of responses with which the interviewee may agree or disagree.\textsuperscript{15}

If some answers are ambiguous, or alternatively, if some answers are interesting and merit further discussion, a valuable technique is to ask additional “probing” questions. These questions provide clarification of specific responses. In some instances, probing questions may involve neutral phrases, used simply to prompt clarification on the part of the interviewee. For example, one might simply ask, “How do you mean that?” In other instances, the interviewer may want to clarify the answer with respect to a particular case or instance, in which case the probing question might be more complex.\textsuperscript{16} In most cases, these probing questions must be considered in real time, and their use is subject to the instincts and judgment of the interviewer.

The interview questions fit into the protocol in four basic sections: (1) the interviewee’s role in the Partnership; (2) the creation of the Partnership; (3) the way the Partnership and its components function; and (4) the accomplishments and legacy of the Partnership. The first section on interviewee’s role in PNGV was provided for several reasons, including: understanding their positions and stake in the Partnership, demonstrating the basis on which they are in positions to provide meaningful and credible opinions, and yielding information that might suggest potential biases in their statements, by virtue of their respective stakes in the Partnership. The second section – applicable only to those involved in the creation of PNGV – focused on what was involved in its design and negotiation. The third section provided a means of better

understanding of how PNGV functions internally. Finally, questions on PNGV accomplishments and legacy most directly addressed the research hypotheses of this study.

Table 7-1 shows the overall flow of the questions in the interview protocol. Questions about identity and role helped provide context for answers provided. A section on the creation of PNGV applied to any interviewees who participated in the earliest days of the Partnership. Another section of the protocol dealt with how the Partnership worked, and a final section focused on what it achieved.
Table 7-1: Types of Interview Questions

<table>
<thead>
<tr>
<th>I. IDENTITY AND ROLE</th>
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<tbody>
<tr>
<td>A. affiliation, duration, job</td>
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<tr>
<td>B. role in PNGV, duration, job</td>
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<tr>
<td>C. level of effort on PNGV</td>
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<tr>
<td>D. familiarity with PNGV</td>
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<table>
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<tr>
<th>II. CREATION OF PNGV</th>
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<tbody>
<tr>
<td>III. PROCESSES OF PNGV</td>
</tr>
<tr>
<td>A. team/effort in PNGV</td>
</tr>
<tr>
<td>B. lessons?</td>
</tr>
<tr>
<td>C. interaction with other PNGV groups</td>
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<tr>
<td>D. observations on management, etc.</td>
</tr>
<tr>
<td>E. team/effort/results without PNGV?</td>
</tr>
<tr>
<td>F. after 2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV. ACCOMPLISHMENTS OF PNGV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. effort/team advances</td>
</tr>
<tr>
<td>B. metrics</td>
</tr>
<tr>
<td>C. perception of PNGV accomplishments</td>
</tr>
<tr>
<td>D. interactions/attitudes among companies</td>
</tr>
<tr>
<td>E. interactions/attitudes between ind and gov</td>
</tr>
<tr>
<td>F. perception of other views of PNGV</td>
</tr>
</tbody>
</table>

Identification of Potential Interviewees

Interview candidates relevant to the research hypotheses were categorized into four fundamental types: developers, participants, affiliates, and non-participants. Developers were those who were involved in the creation of the Partnership, including individuals from White House offices, the Department of Commerce, and the Big Three. Participants were those who participated in the Partnership, including staff from federal agencies, federal laboratories, and OEMs. Finally, “non-participants” was a third group of potential interviewees. Examples for this study could have included staff of foreign OEMs, environmental advocates, etc, though ultimately no more than a few interviews with such non-participants were pursued.
Note that these “types” were not necessarily clear-cut or mutually exclusive, but that was not consequential. The conclusions were not sensitive to these type designations, but the types were helpful in organizing the data collection efforts.

It is important to understand that the choice of individuals for interviews was less sensitive to bias that would be true in a statistical study. The creation and analysis of data in a case study requires the demonstration of certain concepts in support of the research hypotheses, but unless statistics are part of the analysis, there is no requirement that the data be in the form of a random sample. Similarly, it is not important that the interviewees are selected in proportion with the organizations they represent. The analysis did not weight the opinions that resulted from the interviews by how many came from which companies or sectors.

That said, the study benefited from some representation of different types of stakeholders from different organizations. Ideally, the participants interviewed would have included individuals from each participating organization, from as many levels of participation as possible, for example, members of technical teams and directors and corporate vice presidents and chief executive officers. However, the failure to meet this goal for participation at all of these levels does not detract from the utility of the results.

However, the logistics of setting up interviews in a certain time period with a limited budget necessarily meant that the selection of individuals for interviews could not guarantee that the interviewees were representative of their given sectors. The choice of individuals focused on actors central to the Partnership, especially those most closely associated with DOC, DOE, USCAR, and the technical directors and technical teams. The choice also favored known channels and individuals the author had met previously.
There was additional potential bias as the interviews were all conducted at a particular
time during the course of the Partnership’s existence. Finally, due to the demands of
their positions in the Partnership, some individuals interviewed had more time to talk
than others, where longer interviews would have a greater tendency to feature a free flow
of information.

Candidates were selected based on their positions relative to the Partnership and the extent of their experience in those positions.

The next question that had to be considered was how the protocol would be used to interview several distinct types of potential interviewees, to decide whether multiple protocols would be needed for use with distinct types of interviewees. Ultimately a single protocol was used, by which each individual would answer only those questions relevant to his or her position and experience.

Table 7-2 illustrates of the types of interview questions asked of each of the different groups of interviewees. Note that some questions were considered to be “somewhat applicable” to a particular type of interviewee, and those might be asked based on judgment during the interview of his or her role and specific experience. The full text of the interview protocol may be found in Appendix B.
The protocol was tested on a small number of individuals. Using the rationale provided in Kahn and Cannell, the effectiveness and flow of the protocol was assessed and modified prior to the conduct of the remaining interviews.\textsuperscript{17}

### Setting Up and Performing the Interviews

Once interview candidates were identified, letters were sent to inform them that they would be called to request and schedule interviews. These letters included information on the study, and a note from John Sargent, the chairman of the PNGV Task Force at the U.S. Department of Commerce, to encourage participation in this study.
Appendix B provides text from the note from John Sargent. These letters were followed by phone calls to set up interviews. In most cases, candidates responded positively, though no corporate executives at the car companies responded, presumably due to their busy schedules.

All interviews were conducted between November 1998 and December of 1999 in Washington, D.C. and the Detroit, Mich. area. In one case an interview was conducted by telephone, but only after attempting the interview in person. All interviews were conducted by the end of 1999, all during the Clinton administration, while PNGV was still operational.

On the government side, four active management participants were interviewed, as well as five policy officials who helped develop or oversee the Partnership. On the industry side, five industry PNGV managers participated in interviews, as well as eight technical team members or other staff related to team coordination. Two well placed industry observers also participated in interviews.

Each interview started with an explanation of the study, of its sponsorship, and of how the results would be used. Interviews started slowly, focusing on roles or curiosity-driven questions to build a low level of trust and comfort. These questions were often related to establishing the role and credibility of the interviewee, the goal of the first section of the protocol.

Interviews proceeded according to the protocol, but opportunities to build on unique interviewee positions and perspectives were pursued. Many of them launched into stories relevant to protocol questions or the overall topic, and it was often worth

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17 Kahn and Cannell, 1957, pp. 163-64.
pursuing those, at times at the expense of the thorough completion of the protocol. That judgment was based on the individual and how the interaction was working.

While transcribing interview responses quickly and accurately can be difficult, interview sessions were not recorded electronically. One of biggest challenges was to make participants comfortable discussing topics frankly and without hesitation, and even without a tape recorder, some hesitance or caution from interviewees was apparent.

Details on each interview were noted immediately following each interview, and full notes were typed up as soon as was convenient.

Source: Archival Records

Archival records are documents or other records created in the process of some activity of interest—in this instance, the activities of the Partnership or related programs. Examples of such sources specific to PNGV include:

- Speeches and presentations by individuals from PNGV Task Force
- Handouts from regular and special meetings among participants
- Working papers from PNGV Task Force or other participants
- Research abstracts and data on ongoing agency-funded research relevant to PNGV
- Abstracts of past and ongoing federally funded R&D, as reported to agency-based and government-wide databases

Using archival records in this study provides access to information about the processes involved in participating in and managing the Partnership. Archival records are also an economical form of evidence, as they tend to be generated (perhaps repeated regularly) as a part of the operation of the effort in question. Finally, compared to other forms of evidence, archival records tend to have a low amount of self-promoting language, since their intended audience is, for the most part, other participants of the Partnership.
However, one must be careful when making such an assumption – archival records hold their own potential for bias. Judd, Smith, and Kidder note:

The researcher does not control the collection of archival data, so they may be subject to various sources of unreliability, bias, or invalidity… Even the Congressional Record, a rich source of archival data on speeches and official proceedings in government, is edited after the fact by the speakers, so that what appears in the record may not be what was spoken on the floor… Finally, archives are subject to gaps and incompleteness that make it difficult to determine whether the available data adequately represent the population of interest.18

Many archival records were reviewed for the background research for the dissertation. While many of these sources helped the author understand how things developed or what participants were trying to do at various times, this dissertation quotes from statements made only in public presentations.

Other Sources: Direct Observation, Participant-Observation, and Physical Artifacts

The remaining categories of case-study data sources Yin mentions include direct observation, participant-observation, and physical artifacts. While none of these sources of evidence have central roles in the hypothesis testing of this dissertation, they have all had supporting roles in guiding the design of this study, its hypotheses, and its conclusions. For example, direct observation in the form of site visits to USCAR and to campuses of each of the Big Three helped demonstrate how OEMs and suppliers worked together, how they dressed, how easy it was for them to meet, etc. Sitting in on meetings of PNGV technical teams and NRC peer review panels provided further insights on the cooperative process. Participating in government and industry meetings – even in minor

roles – helped understand how different agencies and offices interact. Talking with OEM representatives provided insights into how PNGV fit into the corporate culture and public image.

The physical artifacts are most tangible of these forms of evidence. The prototype vehicles present at industry gatherings and auto shows provided tangible evidence of some of the technical outcomes of the Partnership, which in turn were possible from the cooperation the Partnership made possible. That said, more central to the hypotheses of this dissertation were the author’s experiences as a participant-observer, in which the progress could be seen in how representatives from these companies interacted, both in PNGV-wide gatherings and in the technical teams focusing on specific issues.

Again, insights of this nature are not central to any of the chains of evidence this study requires. Nevertheless, they appear intermittently throughout the analytic treatment, providing personal observations to support other forms of evidence. The author’s personal observations tend to support the earnestness and optimism of the technical staff participating in the Partnership, whatever else might be said of the larger motivations and processes of the companies and agencies they represent.

Methods: Applying Data to the Research Hypotheses

This section provides details on the methods used in this dissertation and their potential for effectively and persuasively addressing the hypotheses. Due to the qualitative nature of much of the data that support this dissertation, there are particularly great challenges in the compilation of evidence and construction of logical arguments.

19 As discussed previously, the author had an early role in the identification of ongoing federal R&D efforts relevant to PNGV goals.
First, the existence of changes in attitudes or practices must be demonstrated. Then attribution of these changes to PNGV must be established. In many cases, such attributions may not be possible to establish, to the extent that they involve teasing out effects of PNGV from what might have happened without it.

Table 7-3 portrays the logic required to address either of the primary hypotheses, and how different types of evidence fits into that logic. Logical arguments for the secondary hypotheses were performed in a similar manner.

Table 7-3: Use of Supporting Evidence

<table>
<thead>
<tr>
<th>Direct support</th>
<th>Sources attribute a change in relationship to PNGV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two-part logic</strong></td>
<td>Sources identify a change in relationship</td>
</tr>
<tr>
<td>Sources attribute change to PNGV</td>
<td>Sources attribute change to PNGV</td>
</tr>
<tr>
<td><strong>Three-part logic</strong></td>
<td>Sources describe relationship before PNGV</td>
</tr>
<tr>
<td>Sources describe relationship after PNGV</td>
<td>Sources describe relationship during or after PNGV</td>
</tr>
<tr>
<td>Sources attribute change to PNGV</td>
<td>Sources attribute change to PNGV</td>
</tr>
</tbody>
</table>

In the first case, “direct support” indicates that the evidence addresses a hypothesis on its own. For example, the following statement from a report from the Congressional Research Service supports the hypothesis directly: “[PNGV] overcomes historical industry-government antagonism and represents the best way to develop very high efficiency automobiles for the next century…”20

More common is what one might call “two-part logic,” where some evidence supports the idea that there has been a change, and later, other evidence suggests that PNGV was responsible for that change. To address the first part of the logic, statements were sought that identify changes in the relationship, even if they don’t attribute the

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changes to PNGV, such as: “The interaction between government and industry most certainly has improved.”

Later, after compiling evidence that supports a change, the primary hypotheses require further evidence to support that PNGV affected the dynamic in a way that could have supported changes that occurred. Here is an example: “PNGV adds the government component, which I think has made the company-lab connection stronger.”

Finally, many sources do not even directly address the change, but provide statements that address either past or current aspects of the relationship. Groups of such statements may be linked together logically to investigate a change in relationship. “Three-part logic,” requires first an illustration of how things were before or early in the Partnership, as shown in the following example: “It’s fair to say that industry and government had an almost unblemished adversarial interaction since at least the early seventies.”

A second step in this logic is to illustrate how things have become more recently, as shown in this quotation: “The presentations and discussions at the Dearborn meeting reflected a high level of cooperation between government and industry.”

The final step of three-part logic is the same as discussed under two-part logic. Particularly in two- or three-part logic, this dissertation takes measures to avoid errors of causation referred to as post hoc ergo propter hoc. Causation cannot be

21 Interview with government manager D, Washington, D.C., October 14, 1999 (name withheld on request).
22 Interview with industry technical staff C, near Detroit, Mich., November 17, 1998 (name withheld on request).
23 Interview with government policy official C, Washington, D.C., December 8, 1999 (name withheld on request). Note that this statement was made long after the time in question.
24 NRC, 1994, p. 17.
established just because an outcome (e.g., a relationship change) followed something else (e.g., PNGV).

In practice, the various sources of evidence (interviews, quotations from periodicals, etc.) are used in conjunction in this dissertation. While it is interesting when one individual participant provided a statement that supports some component of a hypothesis, the power of such observations is strengthened considerably by corroborative statements from multiple sources. This strength is even greater if such additional sources had distinct positions and stakes in making such statements. While consensus is noted when perceived, the dissertation includes and comments on any unique or outlying evidence also noted.

Logic involving the second and third cases in Table 6-3 will tend to be used together, to address the sub-hypotheses of some change in an aspect of a relationship between PNGV participants. Then the attribution of any changes found to PNGV is addressed subsequently.

**Method: Interpreting Interview Results**

The interview results fit into an integrated framework in the analytic chapters, interview quotations and tabulations with those from other sources are woven together. One purpose this serves is that of providing viewpoints of additional individuals not interviewed, providing the possibility for further corroboration. Another purpose this serves is, in a more general sense, to test and support the reliability of any single type of evidence. Similar results from multiple sources provide corroboration and suggest that biases associated with individual responses were not significant.
Preliminary Interpretation of Interviews

Preliminary interpretation of interviews is possible by tabulating interview responses against individual interviewees. Such an approach provides a means of assessing (a) the validity of the study, (b) the completeness of the interview results, and (c) some differences in responses among the interviewees.

First, an early tabulation of results provides a means of quickly and crudely gauging whether the data are supporting the hypotheses. Such an observation provides early support for the validity of the study – little support of the hypotheses early on could suggest reframing the research approach or premise.

Second, the table of responses provides an indication of how well the interview results are addressing the hypotheses. A lack of coverage across the hypotheses would suggest the need for additional data collection. Indeed, an early version of this chart was created during the interview process, highlighting which types of interviewees were underrepresented at that time. However, in making such determinations, it is important that the researcher does not let the preliminary results affect the choice of subsequent interviewees, based on their expected support the research hypotheses that others may not share.

Lastly, tabulation of interim results can highlight preliminary results. For example, a researcher may note interesting differences among interviewees that he or she might not have expected. Preliminary results of this sort can suggest new lines of investigation relevant to the hypotheses.

Interview results examined for any patterns that emerged. Responses to questions were sorted into basic yes/no or good/bad categories. In making this simple abstraction it
was important to capture the overall tone of the response. If the response was mixed, this was indicated as a neutral response. Of course, these sorts of categorization don’t reflect any of the nuances of the full responses, but the intent of this charting is to derive an aggregate impression. The analytic chapters more deeply consider the complete responses.

To illustrate, Table 7-4 charts excerpts from interviews and the codes assigned to them.

Table 7-4: Example of Coding Used for Analysis of Interviews

<table>
<thead>
<tr>
<th>Comment</th>
<th>Change in Relationship?</th>
<th>Attribute to PNGV</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Within the first year of the partnership, the cooperative mode was far better than before. That’s certainly true at the tech level – relationships that quickly developed are still in place.”</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>“Before USCAR, the government-industry relationship was pretty adversarial. It was a common perception that [the government and industry] didn’t get along.”</td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>“A number of valuable relationships between industry and government scientists have developed over the years, some pre-dating the formation of the PNGV program.”</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 7-5 provides a preliminary chart of the interview results. The columns of the chart are the issues that translate most directly to our hypotheses. Many of the interview questions were not directly related, as they fill in much of the story of how the process works or get into particular lessons, barriers, etc. In keeping with the treatment

25 Interview with government manager C, Washington, D.C., October 5, 1999 (name withheld on request). Note that this statement was made long after the time in question.
26 Interview with industry manager E, near Detroit, Mich., December 15, 1999 (name withheld on request).
27 Chrysler Corporation, Ford Motor Company, and General Motors Corporation, written testimony submitted for U.S. House of Representatives, 1996, p. 71. Note that this statement was made long after the time in question.
of the data conceived in the study design, no information has been provided that can be used to link individual respondents with their responses.

<table>
<thead>
<tr>
<th>TOPICS OF INTERVIEW QUESTIONS</th>
<th>Relationship Among Big 3</th>
<th>Relationship Between Industry and Government</th>
<th>PNGV Outcomes</th>
<th>Legacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governing Officials and PNGV</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Industry Participants and PNGV</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Developers and Participants</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Most respondents agreed that government and industry interactions had improved, and most of those credited PNGV. A few exceptions to this seemed to focus on continued procedural/cultural differences between the groups, though all acknowledged at least some improvement. The significance placed by the interviewees on this improvement varied, but in some cases it was valued quite highly.
Many agreed that the inter-corporate interactions have improved, though the credit to PNGV versus USCAR versus other factors was mixed. Perhaps not surprisingly, respondents associated with USCAR tended to credit USCAR and its consortia at least as much as PNGV. That distinction may be due to their heightened awareness of their activities, a greater need to make a distinction between USCAR efforts and PNGV efforts, and perhaps even a desire to maintain credit for their work regardless of PNGV’s ultimate fate.

All interviewees were optimistic regarding PNGV’s accomplishments, and some note accomplishments beyond the three goals. The analytic chapters discuss these accomplishments.

Many interviewees felt PNGV had motivated other governments and foreign OEMs to start or accelerate their own similar efforts, including the efforts of Toyota and the European Council for Automotive R&D (EUCAR). Some interviewees noted that other efforts in turn had added to the priority or the pace of the Big Three’s efforts. A few sources speculated that this focus may even have increased media attention to the goals of PNGV and similar efforts, which may have led, in turn, to increased consumer demand for alternative vehicle technologies.

Some suggested PNGV was a model of sorts, while others felt the PNGV approach was too dependent on the nature and structure of the auto industry. Chapter 11 discusses the extent to which PNGV can be viewed as a model for government-industry partnerships.

A problem with comparisons across subsets of respondents is that these subsets are not necessarily analogous. An obvious example arises when comparing the responses
of government interviewees with those of industry interviewees. Perfectly analogous individuals from these two groups could not be identified, primarily because the nature of government organizations was and is so different from the nature of the OEMs. Differences that contributed to the difficulty include organizational structure, organizational culture, the magnitude and focus of R&D, the time frame of the work, expectations of management, and the basis for funding and evaluation.

Perhaps the best match of individuals across organizations was among the PNGV technical teams. As stated previously, engineers and scientists from government, labs, and industry worked together on these teams to define and pose solutions for technical barriers. However, even at this level, positions of these individuals relative to their own organizations were so different. PNGV research may have been considered applied research by agency participants, relative to the work of their federal peers, while work in alternative vehicle technologies may seem to industry participants more like basic research relative to the types of research involved in the average vehicle. As a result, these individuals working together have differences, if only in how they function relative to their peers in their respective sectors.

Overall, as a method of characterizing the array of opinions of those interviewed for this research, Table 7-5 is crude but effective. The raw interview data and the exhaustive coding is not presented, of course, so the coding has to be taken on some faith. But beyond that leap, the reader can assess for him- or herself whether the interview results achieve any sort of consensus. Perhaps the greatest weakness of the interviews performed and presented to support this dissertation is that they were all performed within a certain window of time in 1999. While this window provided consistency
among respondents, it failed to portray changes of opinion over time, during different phases of the Partnership. Time and budget permitting, perhaps a repeated survey could have addressed the time component, but it did not seem to be worth the effort and expense for this dissertation.

**Method: Content Analysis**

This chapter discusses the broad, unstructured literature reviews conducted for this dissertation. Another mode of data collection that permits more direct analysis involves finding and sorting periodicals in order to perform content analysis, a “technique for making inferences by systematically and objectively identifying specified characteristics of messages.”28 That is, content analysis is the systematic assessment of the content of a specified set of literature.

This dissertation includes periodicals specified and retrieved either by controlling some aspect or aspects of the periodical search or by manually identifying a subset of collected periodicals based on some robust criteria, such as date, specific column in a given periodical, etc. In searching through electronic or other databases that provide access to archived periodical literature, the results of a search depend, in part, on the nature of the contents of the archive. For example, the results of a search for PNGV in such a database will depend on the years covered by the archive, the periodicals included in the archive, the fields over which the archive software searches, etc. In addition, the results of such a search also depend on the terms used in searching the archive. For

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example, a search for “new generation of vehicles” will not find references to “clean car,” “supercar,” “next generation vehicle,” etc.

In research in which it matters what is found or not found in such a search, these factors can contribute to biases in the results, if the researcher is not careful. However, these same features permit a careful researcher to use selective searching to his or her advantage. By knowingly constraining one’s attention to a particular time or periodical or editorial, one can create a narrow but consistent look at a particular subject.

The next section provides the details of how one of the instances of content analysis was set up for this dissertation. This example highlights where content analysis could be used to best effect, due to the availability of a weekly column that aligns well with the interests of the automotive industry. Chapter 10 also includes other instances of content analysis that were less instructive.

A Specific Example of Content Analysis: a Weekly Column from *Automotive News*

One form of content analysis is the analysis of a single weekly column in one periodical over time, across a few topics relevant to PNGV. Each week in *Automotive News*, Publisher Keith Crain expresses his views on significant issues and events in his Opinion column. This presents a set of archived snapshots of attitudes of a well-read voice in the auto industry. By doing a content analysis on Keith Crain’s Opinion column, we can derive an imperfect proxy measure of industry attitudes and concerns. While Mr. Crain cannot be said to speak for the industry, he nevertheless was and is a well-placed, well-read media figure who is positioned to address the concerns of this industry. Content analysis of the *Automotive News* Opinion column appears in Chapter 10; this
section is meant to explain the method and discuss some of the benefits and shortcomings of that analysis.

Ten years of these weekly columns provides a sufficient duration to discern any shifts in his focus or attitudes regarding PNGV. In order to discern subtleties in the topic of the opinions, it is useful to track attitudes not only to PNGV specifically, but also to regulations and to President Clinton's administration in general. Consequently, the author scanned through over 500 weekly columns from 1992 to 2002, and for each one noted whether it touched on any relevant policy or political topics. In each case an attitude was expressed, one or more brief statements demonstrating the attitudes were noted. The criteria for inclusion were simple: if the column provided some opinion or statement about one of the topics of interest, it was noted. If no topics of interest were discussed directly, no note was provided.

Next, a simple method was used to code the results: positive or favorable opinions received a score of plus one, negative opinions a score of negative one, and anything else received a zero. “Anything else” includes tentative assessments, neutral opinions, and other assessments that are neither positive nor negative. This assessment includes some judgment calls, where tentative opinions or strong opinions on tangential topics required some decisions. For example, if the author expresses caution, or provides a positive opinion that is more or less balanced by a negative one, a zero was assigned. An opinion on a subject tangentially related to PNGV generally received a zero, unless the subject or the opinion might be construed to apply to PNGV as well. In general, positive and negative numbers were assigned when an overall opinion was relatively plainly positive or negative, and when the topic of the opinion was clear.
To illustrate, Table 7-6 charts excerpts from Opinion columns and the codes assigned to them.\(^{29}\)

**Table 7-6: Example of Coding Used for Content Analysis of *Automotive News***

<table>
<thead>
<tr>
<th>Date</th>
<th>Comment</th>
<th>Regs.</th>
<th>PNGV</th>
<th>Admin.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/30/94</td>
<td>“President Bill Clinton hasn’t double-crossed the auto industry on fuel economy yet…A Clinton double-cross would be disastrous for improved industry-government relations.”</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11/25/96</td>
<td>“The National Highway Traffic Safety Administration has taken too long to act on airbag safety.”</td>
<td></td>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>1/5/98</td>
<td>“The Clinton Administration gave the American auto industry a reprieve. Instead of increasing traditional fuel-economy standards, the government became partners with the Big 3 in a scramble for what seemed like a myth: the 80-mpg family sedan.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4/20/98</td>
<td>“Some situations in the auto industry scream for regulation. The rollover tendencies of sport-utilities are in that category… So, the warning labels are a good start, NHTSA. They’re only a start.”</td>
<td></td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Note that the first comment provided tentative thoughts on President Clinton’s policies, on the topic of fuel economy regulation, which was the basis for two of the “0” shown. The second comment was negative towards an agency’s regulatory policy, yielding a “–1” in the regulation column. The third comment was an excerpt from a discussion that demonstrated a positive reaction in all three categories. And finally, the third column spoke positively about regulation in general and with respect to the specific case of sport-utility vehicle roll-overs. The final sentences of this last comment implied that further work was needed, but the overall tone of the opinion was positive, yielding the positive score.

Plotting these scores over time, we can create a time-series diagram of the collection of views expressed. In the chart, the time series of unitary positive/negative

\(^{29}\) Appendix C provides a comprehensive table of codes I assigned to this weekly column. I include particularly interesting quotations, though I do not provide the quotations to support every code I assigned.
statements highlights any long-term trends in attitude, as well as periods of time in which certain attitudes prevail. Any such trends or periods can then be further investigated.

Figure 7-1 provides an early peak at a time series of cumulative scores for each of the three topics mentioned previously – regulations, PNGV, and the administration. The meaning of these lines won’t be discussed until Chapter 10, along with other analyses regarding the relationship between government and industry. The figure is included here only as a preview for how the content analysis will be used, for the sake of discussing benefits and limitations of the method.

Figure 7-1: Cumulative Counts of Categorized Automotive News Opinions
The following paragraphs outline some of the strengths and limitations of this method.\textsuperscript{30} In many cases the strengths of this method are also closely linked with the weaknesses.

First, the Opinion column appears at regular, weekly intervals. This regularity provides the benefit of an evenly distributed archive of opinions that can be viewed over time for historical trends. Unlike interviews, which rely on recollections of past events, such archives are free of biases of hindsight. However, as a weekly column, an opinion was expressed at a weekly interval regardless of whether there are new activities on which to report. One result of this can be varying significance of the issues from week to week. It may also be that the regular intervals of this column yielded repeated statements of opinion even when (or especially when) there were few new activities on which to report. That is, if Mr. Crain had any pet topics, they could have had a tendency to appear more often, which would affect the display of the results.

This column provided a single perspective that permits the observation of a shift in views over time. The single perspective, however, means that the views expressed are necessarily of a single individual, who in theory could have had certain personal biases or allegiances that influenced many of the opinions he expressed.

The perspective in question is a well-placed proxy for auto industry opinion. As discussed above, \textit{Automotive News} is a widely read industry publication, and the Opinion column has been a fixture of it for many years. Nevertheless, it is but a proxy, and it cannot completely reflect the sum of attitudes and perspectives over time. Gathering a

\textsuperscript{30}The limitations mentioned here are intended to comment on this method of assessment and not on the objectivity of Mr. Crain or his column. Similarly, assessment based on this column is intended to provide neither criticism nor endorsement of the publication or the Opinion column.
wide range of past opinions through other means, however, is difficult if not impossible, so proxies such as this were sought for representation.

The method used for scoring is simple. This simplicity, however, has come at the cost of more sophisticated methods that might better distinguish between strongly worded, highly relevant views and those that are less directly relevant. This demonstrates a characteristic tradeoff in assessments of this type: while further sophistication of additional criteria or weighted scores would add more subtlety of the scoring, it would also make the method more opaque.

The way the cumulative chart displays results is simple and effective, which again makes the method more easily understood and replicable. However, the simple form of display can be misinterpreted. For example, in a cumulative chart of this kind, a positive slope may simply indicate consistency and not an opinion that continues to improve. If, for example, a columnist were to provide repeated updates on an issue until it was resolved, those updates would appear on the chart repeatedly, possibly adding a consistent positive or negative increment to the cumulative total in a relatively short time frame.

Conversely, if an issue fades from public scrutiny, one wouldn’t expect it to settle back to zero (as that would require negative statements to balance out prior positives, or vice versa), but rather that fewer opinions would be noted over time, and the line would remain flat at whatever cumulative score it had reached. Thus, the relative magnitude, positive or negative, has only limited significance in conveying lasting impressions.

There are several potential biases of this method, including the medium, the method, the scoring, and the interpretation of the results. Regarding the consistent use of
a particular column for a particular periodical, there is the possibility that a political
leaning or other bias of the publication or column that would misrepresent the industry.
Fortunately, this is addressed in part by the analytic concept, in which the results for or
against PNGV are plotted alongside charted statements regarding President Clinton or his
administration.

Regarding the method, there is some bias due to the frequency of reporting at the
times of periodic events and announcement, such as auto shows, regular peer reviews of
the program, and end of each year. In the case of reporting on auto shows, this
association is justified, as the auto shows provide the only current means of public
demonstration of technical progress of PNGV-related activities. Similarly, the
association with periodic peer reviews is justified, in that they provide the only regular
technical/organizational assessment of progress. The many industry summaries that tend
to appear at the end of the year may demonstrate some bias in this regard. This research
addresses the possible bias of key data by comparing analytical results with and without
those data points, testing the sensitivity of analytical conclusions to these data points.

Similarly, the chart emphasizes frequency of comments on certain subjects. News
or activities that continue over a long period of time may be over-represented.

The simplicity of the scoring scheme used presents a bias in that the lack of
indications of magnitude of relevance make passing comments on a topic
indistinguishable from particularly strong statements. This analysis retains the simple
method, however, for the benefits previously mentioned.

Finally, the means of interpreting results could also bias the conclusions. The
human element in reading, scoring, and interpreting the resulting charts introduces the
possibility that the author’s own opinions or expectations can influence the results. This analysis has taken lengths to minimize this potential – including inclusion of evidence in Appendix C, attention to and reaction to causes of potential bias, etc. – but there is no way to remove the potential for bias completely. As much as possible, the analysis organizes the data to form an argument, letting the evidence speak for itself.

Assessment of Data and Methods in This Dissertation

The beginning of this chapter discusses the types of data that are used in case studies, as characterized by Yin. To assess the adequacy of the data and methods this dissertation uses to test the research hypotheses, it is worth reviewing certain concepts that Yin identifies to assess the validity of the results claimed in social science research generally:31

- Construct validity,
- Internal validity,
- External validity, and
- Reliability.

Construct validity is the design of appropriate ways to measure constructs, which are concepts of interest to a particular study. In this dissertation, the most significant constructs are effects on perceptions and behaviors among participants in PNGV. This study directly addresses the question of construct validity in the way it has been structured through the logical arrangement of hypotheses and proofs. From the start, the research centered on the question of how to assess the effectiveness of the Partnership in various respects, and how to demonstrate its successes. Ways to represent and measure these constructs were identified without much difficulty, as the research methods allow
leaving some of these as somewhat abstract concepts rather than conceiving of quantitatively measurable variables upon which the analysis was performed. The dissertation remains conservative in claiming any causal relationships, making such claims on the basis of the logical consideration of such claims by participants and other stakeholders.

*Internal validity* is the extent to which the research methods can adequately support a causal relationship. To this end, data gathering methods were designed carefully, as was the approach for analysis to address the research questions. Where some forms of evidence (such as recent interviews) are subject to biases of hindsight, other forms of evidence, such as archived periodicals, can provide additional support to statements regarding change. Without a central quantitative method, however, the power of the logical arguments made through the case study methods cannot be assessed prior to their construction. Therefore assessment on the effectiveness of the logical arguments must wait until they are constructed, throughout the analytic chapters of this dissertation.

*External validity* is a gauge of the appropriateness of generalizing the findings of a study to other given subjects. The external validity of the conclusions depends to a large degree on how relevant this partnership is and will be to other existing and future partnerships. The goals for this research include characterizing the processes PNGV used and their promise for the potential benefit of others. Thus, this author strives to maximize the external validity of this dissertation. The unit of analysis and the specific research questions were selected to do this. The dissertation provides a large amount of contextual information on this particular organization in this particular industry in order

31 Adapted from Yin, 1989, p. 41.
to maximize the potential benefits to other organizations and/or other industries.

However, as Yin suggests, external validity is not a straightforward concept in case studies:

A common complaint about case studies is that it is difficult to generalize from one case to another. Thus, analysts fall into the trap of trying to select a “representative” case or set of cases. Yet no set of cases, no matter how large, is likely to deal satisfactorily with the complaint… The problem lies in the very notion of generalizing to other case studies. Instead, the analyst should try to generalize findings to “theory,” analogous to the way a scientist generalizes from experimental results to theory.32

Thus, the goal was not to statistically derive what works and what does not work, as would be the case when sampling for survey research. Yin notes that “survey research relies on statistical generalization, whereas case studies (as with experiments) rely on analytical generalization.”33

To perform the analytic generalizations that Yin calls for, the final chapters of this dissertation discuss how the conclusions might apply outside the PNGV setting. While this dissertation does not explore the vast array of current and planned partnerships to gauge specific applicability of its conclusions, the final chapters address how the conclusions apply to the organizational theory of partnerships, which includes aspects of partnership design, direction, and potential outcomes. The application of these conclusions and observations are left to (a) researchers who may combine these lessons with others to more broadly form partnership theory, and (b) developers and managers of partnerships interested in learning from the experiences of PNGV.

32 Yin, 1989, p. 44. Indeed, applied to the subject of public-private partnerships, I argue that whether and how they are set up is strongly dependent on characteristics of the partnership’s field of research, of the characteristics of the industry, and of the existing relationship it has with the government.
33 Yin, 1989, p. 43.
Finally, Yin identifies reliability as the demonstration that the operations of a study can be repeated, with the same results. Specific to this dissertation, the preexisting sources of data, such as documentation and archival records, could be replicated elsewhere. The examples of content analysis previewed in this chapter are generally replicable, with the some potential for minor variance in the characterization of attitudes expressed. The collection of data through interviews is not perfectly replicable, as different interviewers, interviewees, and interview protocol could yield somewhat different responses. However, a similar sample of responses should yield similar results. Additionally, coded summaries of the interview data were produced as part of the analysis, so that this analysis could, in principle, be reproduced. Perhaps the greatest threat to reliability is in the selection of quotations from the many sources in supporting logical chains of reasoning. By attempting to use all quotations relevant to the hypotheses – whether or not they supported the hypotheses – the line of argument is as replicable as possible.

This research takes on all of these challenges with a combination of specifically targeted interview questions, ongoing attention to potential biases, and the use of supporting data to corroborate other observations, whenever possible. Ultimately, it is not possible to logically prove all hypotheses conclusively in a way that can be broadly generalized, but this approach should constitute as solid an argument as possible using the data and means available.
Leading into the 1990s, the long history of regulation and resistance had created a great degree of antagonism between the government and the auto industry. Each new regulatory issue that arose—whether related to safety or emissions or trade—could expect to encounter delays and appeals by industry, which would translate into lost time and money for both government and industry. For its part, the industry was frustrated by shifts in federal and state policies that outpaced the automakers’ ability to respond with shifts in design, materials, or production methods. Stricter regulations on different, interrelated aspects of vehicle production, safety, and sales strained the relationship more and more. While many might have assumed this antagonistic dynamic as a given, in the 1990s some in government and industry sought a change in that relationship.

The first hypothesis of this dissertation is that the Partnership for a New Generation of Vehicles improved the relationship between government and industry. This relationship is important for several reasons. First, willingness to cooperate was a necessary condition for a partnership to work. It would have been difficult to have a constructive, productive partnership – or working relationship – without communication, coordination, and other characteristics of any good relationship. Additionally, an improved relationship between government and industry would bode well for an outcome that surpasses the technical goals of the Partnership: a lasting, meaningful change in the industry through improved understanding, attitudes, interactions, and processes among partners.

Following a brief discussion on this hypothesis and technical matters involved in addressing it, this chapter demonstrates how improvement of the relationship was not
only a useful side-effect of the Partnership, but was an underlying motivation for the Partnership and the way it was implemented. The subsequent sections use evidence to trace the evolution of the government-industry relationship, from its origin to the end of the Clinton administration. The chapter then provides a more focused look at three specific relationships that were key to the larger government-industry relationship: the relationship between technical experts from industry and government; the relationship with the White House; and the relationships with legislators and regulators. The analysis concludes that the relationship between government and industry participants in the Partnership improved during its term, and most observers note the central role of PNGV in strengthening the government-industry relationship in this area. Still, organizational and political obstacles impeded some additional potential gains.

Notes on the Hypothesis and Supporting Data

This chapter sets out to demonstrate that PNGV was responsible for an improvement in the relationship between government and industry. This open-ended hypothesis permits the identification and characterization of changes in the relationship beyond what might have been predicted initially. Indeed, as this chapter will discuss, several participants interviewed cited changes that would have been hard to predict prior to the Partnership.

Once change in the relationship is demonstrated, the research addresses the extent to which that change can be attributed to the policy intervention (i.e., the Partnership). Some sources provide direct statements on the changes in the industry and even go as far as to attribute the changes to PNGV. However, since few sources of data address this change directly, the demonstration of change in the relationship requires the use of a
mixture of data types, sources, and logical arguments. To provide sufficient corroborative evidence, this chapter includes other pieces of evidence that do not, on their own, provide sufficient evidence for both a change and an attribution to PNGV. For evidence of those types, statements must be used in tandem to support the hypotheses. For example, to demonstrate a change in some aspect of the industry, evidence of the state of the industry from times early and late in the partnership is contrasted. However, as Chapter 7 notes, the dissertation is careful to avoid suggesting causation based solely on changes in relationships that chronologically followed PNGV’s creation.

While interviews with PNGV participants help understand the present, books, periodicals, and archival material provide more powerful documentation of the past. Interviews have limited power to characterize the past, because (1) few partnership participants were in positions from which they could characterize the relevant interactions prior to the Partnership, and (2) the passage of time and biases of hindsight degrade the clarity of impressions of past events. Chapter 7 discusses the latter effect with greater detail. Consequently, in this chapter, periodicals and archival documents form the primary evidence for the period prior to and early in the Partnership. Participant statements resulting from interviews provide much greater detail of more recent events, phenomena, and mechanisms. To help recognize potential biases of hindsight, quotations that discuss much earlier time periods are flagged as such.

As a final note on data and methods specific to this chapter, one consequence of the structure of this dissertation is that the chapters address one type of relationship in the

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1 All quotations that recall a time more than two years previous have a caveat in their footnotes. Additionally, the text highlights any cases in which an error in hindsight might be particularly significant in interpreting a comment.
Partnership at a time. For example, this chapter addresses aspects of the relationships between government participants and industry participants, while the next chapter addresses relationships among industry participants. While this treatment is logical, much of the supporting evidence doesn’t fall neatly into bins according the relationships in question. Specifically, many statements refer to the effects of the Partnership on interactions between participants, without being specific about the participants in question. Context helps at times, but often the intended subjects of these statements are ambiguous. This dissertation includes many such statements in this chapter, under the assumption that – without some reason to believe otherwise – broad statements on the Partnership are more likely to concern the central government-industry interaction than the industry-industry interaction. In many ways this chapter discusses the general relationships among the set of participants, in addition to the specific government-industry relationships. At the same time, as some statements have elements that apply to both government-industry and industry-industry relationships, they appear in both chapters.²

**Relationships between Organizations**

The PNGV announcement and subsequent *Program Plan* outlined three primary goals for the Partnership, all having to do with the technical capabilities desired for the industry or for vehicles designed and produced in the industry. In addition, some participants indicated that there was another, less technical goal underlying the Partnership: the goal for an improved relationship between government and industry. As

² All quotations used more than once in this and the following analytical chapters will note prior use in their footnotes.
a first step in thinking about this goal, we will first consider what it means to improve a relationship between organizations, and why the nature of such a relationship is important.

In the broadest sense, a primary indicator of a good relationship between two organizations is simply that they continue to want to work together. However, factors other than attitude are also important. For example, the frequency and types of interactions among the institutions also help mark the health of the relationship. The extent to which each partner understands the motivations and practical constraints of other partners is an indicator of the knowledge gained in working together. The extent to which they form similar objectives as they work together is indicative of how they relate.

However, these characteristics are not only outcomes or indicators of good relationships; they are also elements of relationships that assist in continued success. A positive attitude towards other partners clearly affects the willingness of each to continue to interact. Furthermore, if each partner understands the motivations, practical constraints, and possible actions of other partners, the Partnership should achieve productive results more quickly. Similarly, mutual understanding affects how and how closely partners will work.

Generally, however, improving the characteristics of an institutional relationship is not itself the underlying goal of a business interaction. In general, one doesn’t structure a program for the sake of improving a connection without regard to the benefits for the participants. Ultimately, the quality of a relationship may be best measured by how well it enabled the entities involved to achieve their goals.
Goal 0: Improving a Relationship

In the case of PNGV, a central goal of the Partnership indeed was to implement more fundamental change in the relationship throughout the ranks. Indeed, the shift in emphasis away from the original working name for the program (“the Clean Car Initiative”) to the Partnership for a New Generation of Vehicles appears to be an early indication that the partnership represented more than the cars themselves.

In one interview, an industry representative recalled, simply and clearly: “Government and industry wanted a new relationship.”³ Why was this important? By moving from an adversarial relationship to a more productive one, some felt the technical gains could be enhanced, and other gains might be made possible. While not all sources focused on this as a goal for the Partnership, many speculated on its extent or promise.

At the time of the earliest announcements of partnership possibilities in 1993, General Motors Corporation president and chief executive officer John F. Smith, Jr. said, “We believe government, labor and industry need to work together… We have had plenty of experience with adversarial relations, and I think we all realize now that none of our organizations can succeed without the help and cooperation of the others.”⁴ Smith emphasized the need for more cooperative interactions for the mutual success of all involved.

When the Partnership was formally unveiled in September 1993, a White House press release proclaimed: “This partnership replaces controversy with cooperation, breaking decades of gridlock between the industry and government about the best way to

³ Interview with industry manager C, 1999. Note that this statement was made long after the time in question.
ensure low automobile emissions and high safety standards."⁵ The press release subsequently noted, “This program represents a fundamental change in the way government and industry have interacted in the past and is intended to begin a new era of progress through partnership to address the nation’s goals rather than through the confrontational and adversarial relationship of the past.”⁶

At a 1994 hearing before a House of Representatives subcommittee, Mary Good, Under Secretary for Technology at the Department of Commerce, stated that PNGV’s long term fuel-efficiency goal “is only part of the story. There are also … other objectives less easy to quantify but of enormous long range significance. One is to demonstrate that a spirit of partnership can replace the adversarial nature that has sometimes characterized the Government’s relations with the auto industry.”⁷

A 1998 document of Clinton administration R&D agencies stated that one of PNGV’s motivations was the “desire to achieve fuel economy and emission improvements through a more efficient mechanism than the regulatory approaches of the past.”⁸

Around that same time, industry analyst James A. Dunn, Jr. also observed: “The general atmospherics were as important as the specific goal [of fuel efficiency]. They were designed to signal the arrival of a new era in Washington’s relations with Detroit. It would be an era of cooperation rather than confrontation, but it would not ignore the need for improvements in automotive fuel efficiency and emissions reductions as the Reagan

⁵ The White House, Office of the Press Secretary, “Historic Partnership Forged with Auto Makers Aims for 3-fold Increase in Fuel Efficiency in As Soon As Ten Years,” September 29, 1993b, p. 3.
⁶ The White House, 1993b, p. 5.
restoration had.”⁹ With this quotation Dunn highlighted PNGV’s potential as a break from cycles of federal regulation and regulatory rollback.

Thus, overcoming the adversarial relations was a goal, at least for some in the government side. This is a simple concept, but as it is often overlooked when enumerating the goals, it is worth further discussion and corroboration. In an interview, another government official noted, “Really, the goal was to get everyone to work together.”¹⁰

Analysts outside the industry agreed with the intent and need for a new approach to working together. At the 1994 PNGV hearing, University of Michigan Transportation Research Institute researchers David E. Cole and Michael S. Flynn advocated for the need for a shift in the traditional adversarial stances: “We are not naïve ‘cooperationists,’ believing that industry can or should seek an absolute identity of interests across all economic, political, and social domains. Rather, we believe that these important institutions of our society [the auto industry and the federal government] must shift their historic adversarial stances, recognizing that areas of common as well as conflicting interests exist.”¹¹ Cole and Flynn suggested that PNGV would be a way to make this shift.

Finally, a quotation provided in a 1993 PNGV press package and attributed to a senior Government official perhaps most succinctly illustrates the hope for a shift in

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⁹ Dunn, 1998, p. 71. Note that this statement was made long after the time in question.
¹⁰ Interview with government policy official B, Washington, D.C., November 30, 1999 (name withheld on request). Note that this statement was made long after the time in question.
interaction between partners: “We’re trying to replace lawyers with engineers.”¹² That is, in lieu of the negotiations and lawsuits that characterized the prior antagonistic relationship, the partners hoped to reach their goals—common or distinct—through improved interaction and joint technological improvement.

**Skepticism Regarding Industry Motivations**

Before we discuss whether the Partnership had an effect on government-industry cooperation, it is necessary to address some of the skepticism that was expressed over time regarding the motives of industry in entering the Partnership.

Some analysts of the Partnership suggest that the auto industry was motivated to cooperate—or even just appear to cooperate—with the federal government only because the industry stood to (a) receive R&D funding from the government or (b) avoid or forestall potentially costly regulation. The more skeptical of these assessments suggest that the Partnership wasn’t meaningful as these motivations equate to no real interest on the part of industry in working with government toward alternative technologies. Fortunately, for reasons discussed below, it appears to be unlikely that these were the sole motivating factors behind industry’s interest.

On the first accusation, some have charged that industry was an eager participant as it simply sought more federal funding. Many of such charges have equated the Partnership to corporate welfare. For example, New York Times columnist William Safire provided this commentary on PNGV: “What a marriage: the Washington-knows-best set of liberal Democrats going down the primrose path of industrial policy with a

posterior-protecting bunch of corporate managers and business lobbyists who think they can get government money and management without government control.” Clearly, Mr. Safire wasn’t a supporter of PNGV in general, and he dismisses industry’s interest in participating as a way to get government funding. He and others assumed that PNGV would result in new federal funding available to industry, but did that happen?

Robert Chapman, the first chairman of the PNGV Technical Task Force at the Department of Commerce attempted to dispel this perception: “There’s a common misconception that this $300 million is all pipelined to these guys [the Big Three]… We have identified all of the technology efforts relevant to the program. And that is different from saying we are funding the auto industry for that amount. It’s utilizing R&D that’s already going on within the government.” Mr. Chapman explained that the approximately $300 million of federal funding associated with PNGV was the combination of all federal efforts that were relevant to PNGV, including not only contracts but also in-house research. And this PNGV “budget” consisted mostly of redirected efforts among existing programs, primarily at the Department of Energy.

And while a portion of PNGV funding initially went to OEMs, PNGV funding provided directly to the Big Three was later reduced dramatically. In a 2002 article, researcher Daniel Sperling discussed this issue:

From the start, the corporate welfare criticism was largely unfounded and became less so over time. Initially, about one-third of PNGV funding went to the automakers. That was largely carried over from already existing programs, and most of it was passed through to suppliers and other contractors. In any case, the amount steadily dropped to less than 1 percent by 2001. Although definitive data

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are not available, in the latter years of the program, more than half of the funding went to the national energy labs, and most of the rest went to a variety of government contractors, automotive suppliers, and nonautomotive technology companies, with universities receiving well under 5 percent. The automakers also provided substantial matching funds, though a major portion of this spending was in proprietary product programs.\textsuperscript{15}

One 1993 press characterization of PNGV went as far as to say that since PNGV involved so little new federal funding it was “industrial policy on the cheap.”\textsuperscript{16}

Even if all $300 million had gone straight to industry, it’s worth putting that in perspective. A few hundred million dollars is a relatively small amount of money for industry, which often puts far more funding in developing a single new vehicle. In characterizing the existing industry production structure, the PNGV office once estimated that the Big Three had over $115 billion invested in production plants and equipment in the mid-1990s, and their suppliers had nearly $50 billion in other infrastructure investments.\textsuperscript{17}

In summary, while it is easy to believe that industry would be happy to receive more money from the government for R&D, it appears that little federal funding went to the OEMs, and, even if it did, it is hard to picture that they would be willing to shift their operations dramatically for such small amounts of federal money relative to their much greater expenditures.

\textsuperscript{15} Sperling, 2002, p. 86.
\textsuperscript{16} John Carey and Mary Beth Regan, “Here Comes the Uncle Sam-Mobile,” \textit{Business Week}, October 11, 1993, p. 32.
Was Industry Motivated Primarily by the Hope for Less Regulation?

Instead of characterizing industry’s motivation as a hope for more federal funding, other assessments suggested that participation may have been an attempt to work to forestall regulation. For example, one assessment from 1994 reported that skeptics “claim the supercar project is just a stall by the carmakers – a cynical effort to get the White House to delay new fuel economy, safety and emissions standards.”18 The Sierra Club called it “a scam to keep regulation at bay.”19 Ralph Nader called it “a smoke screen behind which the automakers hide to protect themselves from more stringent air quality standards.”20

A number of other sources provide a similar assessment.

At least some of the key government participants agreed that forestalling regulation was a motivation for the industry. In characterizing the Clinton administration’s first discussions with the automakers, Rob Chapman, original chairman of the government’s PNGV Technical Task Force, acknowledged in 1998: “It is fair to say that the primary motivation of the industry was to avoid federally mandated fuel efficiency and emissions standards.”21

While there seems to be some agreement that avoiding regulation helped motivate the industry, not all would agree that, as some skeptics suggested, industry participated with that motivation without any particular interest in developing new technologies. After a 1993 meeting with White House officials, Chrysler vice president Francois Castaing

suggested a different dynamic: “If improvements in fuel economy are done on a voluntary basis because they make sense, then all debate about regulation goes away.”

On the government side, Mary Good at the Department of Commerce expressed similar thoughts. When asked if industry cooperation was just a stall, said she had the opposite impression. Indeed other participants noted that when government and industry work cooperatively toward common goals, increased regulation (and the associated antagonistic relationship) isn’t needed.

One way to consider this more positive view of industry involvement to consider the dilemma industry had faced in the past – when they had succeeded in demonstrating technological improvements affecting automotive externalities, government would respond by requiring the use of those technologies. By that logic, if industry does not intend to pursue alternative vehicle technologies, it is not in their best interest to demonstrate the feasibility of those technologies, given the tendency of regulators to require the use of technologies once proven feasible. Their reluctance would logically be heightened further in this instance, where it is not clear that consumers will demand alternative technologies that would almost certainly cost more than conventional technologies, at least in the short term. One 1993 analysis characterized this dilemma this way:

While they [the auto makers] are happy to talk to the White House about receiving more federal research funds, they are deeply concerned that the clean-car initiative could leave them vulnerable to political pressure to accelerate their plans to improve the mileage and emissions controls of their existing fleets… They worry that if the administration announces that the industry has agreed to join in a project that would have as its goal improving auto mileage standards by a

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certain amount, the pressure would suddenly build in Congress to pass new laws absolutely requiring the industry to meet those targets… \(^{24}\)

Indeed, in 1994 Peter Pestillo, a Ford executive vice president who handled governmental affairs at the time, noted of PNGV, “This initiative has a lot of potential if they are sensible about it, and if they look at it as a long-term research project… The thing I worry about is whether in the course of agreeing to the clean-car initiative, you would be committed to accepting dramatic increases in fuel economy.”\(^ {25}\)

In summary, it is doubtful that industry was motivated solely by federal research funding to participate in the Partnership, as the magnitude of federal funding to the OEMs was small relative to related industry investments. Meanwhile, industry involvement in the Partnership may have been motivated in part by the incentive of avoiding new regulatory increases while it worked with the government. However, that is not the same as saying that industry had no intention of working toward a productive partnership. Indeed, the activities noted in this and subsequent chapters suggest productive engagement on their part.

Additionally, even if these factors had some role in motivating industry, their existence does not negate the question of whether the Partnership that resulted had a positive effect on the government-industry relationship, the hypothesis of this chapter.

**A Changing Relationship between Government and Industry**

The following sections chronicle the progress in the relationship between government and industry from the time before the Partnership. From the prior,


adversarial relationship, shifts in policies enabled and led to the development of the Partnership itself. Following a discussion of the changes in the relationship that resulted, a subsequent section assesses the extent to which those successes may be attributed to PNGV.

An Adversarial Relationship

Even a passing familiarity with the automotive industry prior to the 1990s is enough to be familiar with the characterization of the “adversarial” nature of the relationship between government and the industry. Many interviews with participants in PNGV underscore this observation. For example, in one interview an official from the Clinton administration made the following observation on the relationship in prior decades: “It’s fair to say that industry and government had an almost unblemished adversarial interaction since at least the early seventies.”

At the White House PNGV announcement in September 1993, Ford chairman and chief executive officer Harold A. Poling said: “Not too long ago, we regarded government as an adversary, and government felt the same way about us.”

Robert J. Eaton, chairman and chief executive officer of Chrysler, referred to the relationship as “a quarter century of head-butting hostility.”

As another example, an industry official noted that prior to PNGV “any conversation was a negotiation – a win-lose game. Both between companies and between

26 Interview with government policy official C, 1999. Note that this statement was made long after the time in question.
28 Quoted in Gruley and Gannon, 1993, p. 1D.
industry and the government." The auto industry appears to be a prime example (if not the prime example) of an industry in a seemingly perpetual battle with federal and state policymakers.

The reasons for the policy battle are not difficult to understand. This extremely large industry produces a product that is considered by some to be central to the American way of life, a product that is highly significant to the nation’s economy and trade balance, and also one that is associated with societal problems of pollution, energy generation, and public safety. The production and use of a single product thus plays several interrelated roles – both positive and negative – in our society and economy.

Two quotations help illustrate the some of the differences in perspective that have exacerbated the resulting regulatory tug of war. In a 1994 book, historian John Rae noted:

The overall response of the motor vehicle industry regrettably followed a pattern that applied to every major public policy issue affecting the industry during approximately the twenty years from 1955 to 1975. First, industry spokesmen denied the problem existed; they then conceded that it did exist but asserted that it had no solution; finally, they conceded that it could be solved but that the solutions would be very expensive, difficult to apply, and would require a long time to develop.

Rae’s perception is not uncommon. Compare that perspective with the following commentary in an industry periodical:

Why, with all the industry has done, does it have such a bad image? Perhaps we can look to how the nation’s regulatory process has developed. Rather than working together, industry and government have been placed in adversarial roles. The regulators’ job has been to ask for too much, too soon, and it has been industry’s job to say “too much, too soon,” forcing mistrust between the two…

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29 Interview with industry manager D, 1999. Note that this statement was made long after the time in question.
The long lead times of the industry contribute to this tension. Regulators work well into the future in setting rules… Regulators are less risk-averse [than industry], since they control the flexibility to adjust standards later… There are cases where the risk was high, but we were able to pull it off. These have been added to the folklore as ‘Detroit complains, then does it.’

Other statements may be found in support of each of these views. For example, a 2002 chronicle of the end PNGV from the Chicago Tribune summarized both sides of the story:

The automakers defended their interests relentlessly, particularly when Washington demanded new rules on safety, pollution and fuel economy. Detroit complained that Washington was often seeking new regulations without considering whether the industry had the money or the technology to meet those standards… But Washington thought Detroit was not trying hard enough--that it frequently claimed it could not meet new standards, then proved that it could.

One industry representative interviewed summarized the motivation for a new way of doing things by asking, “The question was, how could you transform a very adverse relationship between government and industry?”

An Alternative to Adversarialism

By the early 1990s, there were reasons to anticipate changes in the government-industry dynamic. Congress had passed legislation that would allow increasingly cooperative modes of interaction among companies and between government and industry. As a presidential candidate, Bill Clinton’s campaign had included the Big Three in discussions and plans for potential partnerships. Not long after his election,

33 Interview with industry manager C, 1999. Note that this statement was made long after the time in question.
President-elect Clinton and his transition teams had struck up a dialogue with individuals at the Big Three.34

In response to the election results, Crain proclaimed in Automotive News, a leading weekly industry periodical, “The industry’s relationship with Washington is going to change, and that change could be quite dramatic.”35 Prior to the start of the new administration, Crain and others expected change, presumably based on the tone and promises of Mr. Clinton’s campaign.

Six months later, Crain was more specific about what such a change could mean: “We have come a very long way in the last 25 years [of government involvement]... And it was done in a confrontational atmosphere, which made it more difficult. The government is in the auto business to stay. Wouldn't it be wonderful to see what we can do if everybody cooperates during the next 25 years?”36

At nearly the same time Crain made the latter comment, Ford chairman and chief executive officer Harold A. “Red” Poling summarized the change when he said, “[There is] a new spirit of cooperation among the auto industry, labor and government.”37 These quotations show first indications of the increasing hope those related to the automotive industry had for a shift in the relationship between the two entrenched adversaries.

34 Depending on the need for a detailed history chapter, I could simply provide some of the history of the connection here.
37 Quoted in Gruley and Gannon, 1993, p. 1D.
Birth of the Partnership

On September 29, 1993, in the first year of the Clinton presidency, the White House released the plan for the Partnership in a document called *Declaration of Intent*. This plan painted a hopeful picture for the outcomes of the Partnership:

This program represents a fundamental change in the way government and industry interact – a shift to a new era of progress through partnership and cooperation to address the nation’s goals, rather than through the confrontational and adversarial relationship of the past. This new public policy of partnership and cooperation will permit dedication of private and public resources to programs designed to achieve major technological breakthroughs that can make regulatory interventions irrelevant.\(^38\)

Soon after, President Clinton spoke on the promise of the Partnership: “[PNGV] represents a major step in breaking down the decades of mistrust between the federal government and the Big 3 over fuel economy, emissions, and safety issues. Whether a new car is invented or not, the agreement will break down the wasteful gridlock over regulation of the automobile industry.”\(^39\) Note that the President highlighted the tension over the regulatory issues, and highlighted the potential benefit even without the creation of the vehicles themselves.

Statements at that time by stakeholders in industry supported this vision. Jack Smith, Chief Executive Officer of General Motors, said, “Crucial to this revolution is the way in which we plan to achieve it – through partnership and cooperation rather than the old command-and-control adversarial approach of the past.”\(^40\)

Larry D. Weis, a spokesman from USCAR noted, “We have worked together before in bits and pieces, [but the new agreement] commits the Government and the


\(^{39}\) Gates, October 4, 1993, p. 41.
companies to sit down in a coordinated effort; it becomes more of a moon-shot kind of program."41 That is, while the government had previously provided limited support for alternative automotive technologies, it had not worked together with competing companies towards a common goal (partly due to legal barriers, until legislative changes of the 1980s).

Gerald Esper, a representative of the American Automobile Manufacturers Association, later added, “We’re proposing to come forward and say, ‘We’ll stop fighting.’ No more lawsuits, no more litigation, no more our calling you names, you calling us names.”42 These statements show that some in industry recognized the problems of the past adversarial relationship hoped for a change.

The press greeted the announcement primarily with a mixture of disbelief and hope. Crain said, “Some exciting news came out of Washington last week. Who would have believed that the U.S. government and the Big 3 would actually get together on a cooperative project?”43 Another reporter declared, “After a quarter century of head-butting and mistrust, Washington and Detroit have agreed to park their adversarial relationship and join forces.”44

Industry analysts made similar observations. Of the initial days of the Partnership, one industry observer later exclaimed, “On September 29, 1993, the unthinkable happened. After decades of adversarial posturing, and months of intensive

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40 Quoted in Johnston, 1997, p. 56.
negotiations with Vice President Al Gore, the heads of the Big Three auto makers accepted President Bill Clinton’s challenge to collaborate.”45

Another commented on the tone of the PNGV announcement itself: “…the announcement had something of the look of a treaty between sovereign powers.”46

Early Hope and Caution

In the opening months of the Partnership, reaction to it and the hope for a shift in the adversarial relationship continued to appear in the press. Crain related that the Big Three were “even talking to Washington in a mutual spirit that things can be done for the economic good of the industry and the nation. And it appears that the government agrees with that for the first time.”47 He later added, “1993 was a very good year... Bill Clinton… actually does envision the government working together with the industry to solve societal problems.”48 Clearly, Crain was optimistic for the shift in attitudes.

Another reporter echoed a similar note of hope: “We have for most of our industrial history in this century witnessed a tripartite warfare based on mistrust, distrust and even physical conflicts. Recent events in our nation’s capital suggest that a new spirit of cooperation may be possible.”49

At the same time, there remained some more cautious voices in the industry. This is understandable, if for no other reason, because Vice President Gore had previously all

46 Dunn, 1998, p. 71. Note that this statement was made long after the time in question.
49 Thomas L. Bryant, “Can the government really help?” Road & Track, January 1994, p. 22.
but declared war on the auto industry in his book *Earth in the Balance*. In that 1992 book, he described the conventional automobile as “a mortal threat to the security of every nation that is more deadly than that of any military enemy we are ever again likely to confront.”

This thesis has many quotations from Keith Crain’s weekly editorial in *Automotive News*, as Crain often comments on actions that the government has taken that affects the auto industry. In a noteworthy break from his typical style, in 1993 Crain reported a “good friend’s” warning regarding the new administration, prior to the PNGV announcement: “Regardless of what you thought about the Reagan-Bush years, he said, here was a gradual slowdown in regulation from Washington. Under Clinton, activity is going to crank up dramatically.” While Crain was careful to attribute the warning to someone else, he presented it in such a way as to highlight his respect for this other individual’s opinion, even if, as shown in other quotations previously, that opinion appears to be counter to his own. Nevertheless, in a later column, Crain pondered, “The Big 3 and the federal government have been at each other’s throats for a generation. Will they really be able to cooperate on anything?”

Indicative of the caution of the participants early in the Partnership, Andrew H. Card, then president and chief executive officer of the American Automobile Manufacturers Association, also expressed some words of optimism mixed with caution in his statement at the 1994 hearing on PNGV. He stated:

The word ‘partnership’ and the word ‘cooperation’ may overstate the situation. I think that we have a skeptical relationship with government and government has a skeptical relationship with the automobile industry. But that skepticism is much better than the cynicism that used to exist with both of those entities.

And this skeptical relationship that we are calling a partnership has great potential, and I emphasize potential rather than a firm objective way of saying we have done it.

We are testing each other in this process. We feel very strongly that real market conditions have to be considered while government takes a look at what has been in the past a command and control effort to impose ideas on industry or society, and that new skeptical relationship is one that we hope will teach something to the government side while the industry learns something about the societal objectives addressed through Congress or through regulators. So this is something new.

Card portrayed the caution of all participants in entering into this partnership. He warned against reading too much into the words “partnership” and “cooperation.” At the same time, however, he appeared to be optimistic for the results, and noted that even the skepticism was an improvement over the prior cynicism.

Partnership participants from government later expressed similar reservations in interviews. For example, one said: “Both sides were wary about what the other side was trying to get out of the arrangement. The car companies were skeptical of what the government would be putting in…. The automakers were wary of each other, the Vice President, and the government…. Their wariness would go in waves.”

Of course, some of the skepticism of the Partnership was from stakeholders that were outside the Partnership. Some were skeptical of President Clinton’s motives in participating. According to one industry analyst, “A publication of Public Citizen,

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52 Keith Crain, “Super car project faces obstacles on both sides,” Automotive News, October 18, 1993, p. 12. As shown later in this chapter, Crain’s attitudes towards President Clinton’s policies become less tentative with time.


54 Interview with government policy official E, Washington, D.C., December 29, 1999 (name withheld on request). Note that this statement was made long after the time in question.
headed by Joan Claybrook [a frequent Nader colleague]… alleged that ‘President Clinton’s retreat from his campaign promises to raise fuel economy standards is widely seen as an attempt to affirm his cozy relationship with the U.S. auto industry.’”\textsuperscript{55}

As noted earlier in this chapter, some critics of PNGV cited the potential relaxation of regulations (especially fuel economy standards) as the only reason for industry cooperation. But others saw this same motivation in a very different way. One government participant of the Partnership noted that the industry “saw the possibility of a new era – which could reduce the time they spent on regulatory issues. And they could simultaneously increase competitiveness.”\textsuperscript{56}

In 1994 Susan F. Tierney, at the time the Assistant Secretary for Policy, Planning, and Program Evaluation at the Department of Energy, asserted that the Partnership was not intended to simply stave off further regulation. Instead, she noted, “We see an enormous impasse with costs and benefits in many places… It’s not a holding action, but a desire to try something different.”\textsuperscript{57}

Also on the government side, Ellen Seidman, special assistant to President Clinton for economic policy at the National Economic Council, noted the limitations of regulatory approaches: “This is a complicated issue that if you attempted to solve it just by jacking up [fuel-efficiency] standards you’d end up in a regulatory and legal

\textsuperscript{55} Johnston, 1997, pp. 56-57.
\textsuperscript{56} Interview with government policy official E, 1999. Note that this statement was made long after the time in question.
morass.”58 Others have noted that the relaxation of regulation isn’t necessarily a bad thing if the need for the regulation ceases to exist through other means.59

As if to summarize the argument for allowing new ways of interacting, in 1994 Mary D. Nichols, EPA Assistant Administrator for air and radiation during the Clinton administration, suggested that the Partnership was based in “a desire to engage in constructive dialogue and partnership with industry at the same time that you’re developing regulations and enforcing them.”60

From Guarded Optimism to Successful Collaboration

Among the would-be participants in the Partnership, things got off to a good start almost immediately. Regarding the April 5, 1993 negotiations at USCAR in Dearborn, Michigan, USCAR executive director Donald Walkowicz recalled, “We really walked out of there saying that what we wanted to do was [establish] a new way of doing business between industry and government… The old command and control techniques just didn’t work. We’ve got to quit being adversaries and recognize where we do share a common vision.”61

Similarly, many in the automotive press noted the new possibilities and more positive atmosphere. In an Automotive News editorial column from 1993, Crain observed, “We have a level of government-industry cooperation that has never been seen before. Whether this love affair will last is iffy. But while it lasts, it is something to

58 Quoted in Stone, 1994, p. 1176.
60 Quoted in Stone, 1994, p. 1176.
61 Quoted in Buntin, 1997a, p. 10. Note that this statement was made long after the time in question.
The following month, Crain added, “As with any relationship, government and industry must nurture what is good and growing. There is still a lot to be done, and a lot of history to undo.” Crain appeared unsure of how much faith to put in the apparent changes underway, but he seemed hopeful.

A few years into the Partnership, Buntin noted the attitudes of industry executives regarding the Partnership: “Even with its timetables and mileposts, PNGV seemed to be a clear break from a disagreeable past.” Participants on the industry side recognized the improvement. Ronald York, the PNGV director from General Motors, recalled in 1997, “There was an impression that was pretty high that this was not going to be business as normal.” Thus, some within the industry recognized a change in the interactions between government and industry, and they saw certain advantages in this change.

Analysts and industry experts also noted the improvements. One PNGV study identified the “unprecedented collaboration between Motown and the Beltway that rises above past acrimony associated with ‘government’s perceived intrusion in the marketplace’ and ‘industry’s alleged lack of responsiveness to issues of public concern.’”

Another journalist similarly observed, “Everyone agreed that it was refreshing to have conversation rather than confrontation. After all, for nearly 30 years, the two

63 Keith Crain, “Clinton, Big 3 are friends, but it’s just a start,” Automotive News, January 17, 1994, p. 12.
64 Buntin, 1997a, pp. 17-18.
65 Quoted in Buntin, 1997a, pp. 17-18.
entities have been arguing over emissions controls and fuel-economy regulations, plus all the other contentious issues.”67

Another added: “Peace has broken out in … the American auto industry… The parties have a can-do cooperative spirit that could end years of haggling over emissions, safety and other issues.”68

A few years into the Partnership, yet another journalist summed up the shift in the relationship: “Oil and water. The Hatfields and McCoys. Ralph Nader and the Corvair… The auto industry’s relations with Washington for most of the last three decades have been contentious, to put it mildly.” He continued, “More recently, especially for the Big Three, relations with Washington have edged slightly in a more cooperative direction…”69

Another journalist suggested the prototypes unveiled in 2000 were the result of this shift in the tone of the relationship:

[New Ford and GM vehicles] are the first real results of unprecedented cooperation among the American auto companies and federal government… The mostly cooperative effort to produce a supercar marks a major departure from the historically adversarial relationship between the government and the auto industry, among the most regulated consumer industries in this country.70

Both government and industry participants interviewed noted the positive effects of the Partnership. One government participant observed, “Instead of getting caught up in ideological diatribes, we tried to ID things we can agree on. It had a very therapeutic


67  Bryant, 1994, p. 22.
effect. We really created a conversation at very high levels and at very low levels – it helped create an atmosphere.”

Another government participant added: “The interaction between government and industry most certainly has improved. Well, if I can’t make that as a blanket statement for all of government, it’s true for DOE and DOC.”

On the industry side, interviewees noted both the need for and the effect of a change. One insisted: “[PNGV is] absolutely necessary. You can’t be in an antagonistic relationship and be productive.”

Another observed: “To get everything you want done, within budgets and at the same time achieving societal goals, it makes sense to work together.”

Yet another said, “PNGV represents a departure on the way we do business with the government.”

And a fourth concluded: “There has been a change over time. The interaction has improved – it’s become more focused.”

Finally, outside review entities noted the improvement in the relationship. A Congressional Research Service overview of the Department of Energy R&D stated: “[PNGV] overcomes historical industry-government antagonism and represents the best way to develop very high efficiency automobiles for the next century…”

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71 Interview with government policy official C, 1999.
72 Interview with government manager D, 1999.
73 Interview with industry manager D, 1999. Note that this statement was made long after the time in question.
74 Interview with industry manager E, 1999.
75 Interview with industry technical staff H, near Detroit, Mich., November 18, 1998 (name withheld on request).
76 Interview with industry technical staff D, near Detroit, Mich., November 18, 1998 (name withheld on request).
77 Rowberg, 1997, p. 17.
Likewise, the first in the series of independent PNGV peer reviews by the National Academies specifically highlighted the success in the cooperation and interaction between government and industry:

The presentations and discussions at the Dearborn meeting reflected a high level of cooperation between government and industry. It is noteworthy that personnel from the diverse cultures of government and industry were working effectively together while fully embracing the goals of the PNGV. In the committee’s judgment, the enthusiasm and working relationships that have developed in the PNGV are commendable. With this rapid, initial accomplishment, the PNGV has made a good start. 78

Many of the quotations used in this chapter reflect the attitudes of participants about the extent to which the relationship between government and industry changed since the time before there was a partnership. Table 8-1 summarizes the opinions of all of the participants interviewed, where each shaded “x” characterizes whether a change was noted in each interview. A more lightly shaded “?” indicates that a particular interviewee’s comment had some ambiguity but could be interpreted to indicate the opinion noted.

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<th>Change in Relationship</th>
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<th>Government Interviews</th>
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Clearly, nearly all government and industry participants that responded to this question not only noticed a positive change but also perceived an improvement in the relationship during this period. None of the participants suggested there was no change or a negative change.
**Attribution of Success**

This chapter constructs the argument that the government-industry relationship improved, and it implies that PNGV was the cause. Let us consider other possibilities that might also explain this.

For example, perhaps other things were occurring in the auto industry or market for vehicles that could have accounted for some of these effects. Perhaps other things were going on in government or the larger society or economy that might account for them. Perhaps there were international pressures or effects at the time, as well. Certainly at least some of these things were happening, but the issue is whether some of these other explanations might provide alternatives to the primary role of the Partnership in contributing to the effects on the relationship this chapter describes.

One government participant commented on how difficult it was to attribute many of the improvements in the relationship to PNGV specifically, saying that the improvement in cooperation wasn’t “all necessarily because of PNGV – it’s hard to sort it all out. The AIAG – that’s the auto industry action group – worked very hard. So it’s not just PNGV – it’s hard to argue it either way. There’s certainly a closer working relationship, and it’s a different working relationship.”

More specifically, some stressed the role of USCAR itself in improving the government-industry relationship: “Before USCAR, the government-industry relationship was pretty adversarial. It was a common perception that [the government and industry] didn’t get along.”

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78 NRC, 1994, p. 17.
79 Interview with government manager C, 1999.
80 Interview with industry manager E, 1999.
Others, however, noted that USCAR was more limited in what it could accomplish without PNGV. A government participant interviewed suggested that USCAR was still young when PNGV was formed: “The industry folks will point out that USCAR was created previously, but it was really just getting started [when PNGV was created].”81 In this statement, the speaker implied that PNGV deserves at least some of the credit for USCAR’s success. The same speaker continued: “PNGV enabled USCAR to grow. It became far more effective than it would have been otherwise.”82

An industry participant asserted that PNGV strengthened the USCAR capabilities: “With USCAR, industry has always wanted to collaborate. PNGV adds the government component, which I think has made the company-lab connection stronger.”83 In this way PNGV may have prompted industry to do more through USCAR than it would have otherwise.

Other participants felt there were other, clearer successes that were due to PNGV. An industry manager acknowledged, “Without PNGV, [the automakers] couldn’t tap the labs… OEMs wouldn’t put staff on the same problems… With PNGV, everything is aimed at national goals. Working separately, our efforts would have nowhere near the power this has. [The effect of PNGV is] very major – industry changing.”84 The alignment of government and industry partners towards consistent goals may have had a

81 Interview with government manager C, 1999.
82 Interview with government manager C, 1999.
83 Interview with industry technical staff C, 1998.
84 Interview with industry manager A, near Detroit, Mich., December 10, 1999 (name withheld on request).
more direct effect than would have been possible otherwise. Indeed, the same speaker declared, “Not on your life would these cars be out in January [2000] otherwise.”

Finally, in describing the difference in approach of the Partnership, one industry representative interviewed provided the following analysis: “The model for cooperation had been vertical only, with the government. PNGV added a horizontal component.”

Unfortunately, it is impossible to conclusively attribute many of the specific effects seen in the industry to the interactions through PNGV. The magnitude, dynamics, and influence of the automotive industry make it difficult to confidently interpret the many processes and interactions going on in the industry at a given time. Nevertheless, the weight of corroborative evidence suggests that the improvements seen in the relationship stem primarily from the Partnership itself.

Using the framework of Table 8-1, Table 8-2 summarizes the opinions of all of the participants interviewed on whether PNGV was the cause of the improvements they perceived in the relationship between government and industry. Again, each shaded “x” characterizes whether a change was noted in each interview. A more lightly shaded “?” indicates that a particular interviewee’s comment had some ambiguity but could be interpreted to indicate the opinion noted.

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85 Interview with industry manager A, 1999.
86 Interview with industry manager D, 1999.
Table 8-2: Interview Opinions on Relationship and Attribution to PNGV

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<th>Change in Relationship</th>
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<th>Attribute to...</th>
<th>Industry Interviews</th>
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<td>Other</td>
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Of the 13 industry participants interviewed, all perceived a change, and seven attributed it at least in part to PNGV. Only one industry participant felt that the change was due to something other than PNGV (specifically, the U.S. Advanced Battery Consortium). Of the nine government participants interviewed, eight perceived a change and attributed the change to PNGV. While the government interviewees almost all attributed a change in relationship to PNGV, industry interviewees agreed, but with less unanimity regarding the cause for change.

**Some Skeptics Hopeful**

Much of this dissertation focuses on the positive results of the Partnership. The compilation of associated statements should not be interpreted to suggest that PNGV was without its critics and skeptics. Examples of certain problems raised by skeptics are included in the discussions in Chapters 9 and 10 on the persistent barriers or problems in smooth cooperation. But even among these skeptics, some saw reasons to be optimistic. Some conceded that the Partnership resulted in some limited successes. For example, in a Congressional briefing that outlined what didn’t work about PNGV, John DeCicco of the American Council for an Energy-Efficient Economy said that PNGV provided a
“landmark articulation of shared objectives.”\(^87\) That is, part of the value of the bringing government and industry together was the identification and articulation of the goals themselves.

Roland Hwang of the Union of Concerned Scientists suggested in 1998, “What’s happening is the auto companies are vying for the mantle of environmental leadership, looking towards the 21st century and saying ‘if we fall behind the curve here, we could be gone’… But if the auto companies really want to do something, they need to make more than announcements. They need to sell green vehicles.”\(^88\)

Speaking of hybrid vehicles, in 2000 Senior Research Associate Michael Brylawski at the Rocky Mountain Institute, explained: “This is a really good step in the right direction… We’re seeing the transition from why to how. [The carmakers] know why. Now they want to know how.”\(^89\)

Other skeptics seem to have been won over to believe in the Partnership. On the government side, Commerce Secretary William Daley observed the change in some attitudes towards the Partnership: “I have met with the executives involved [in PNGV]. The progress is real. Even those who were skeptical originally are now excited.”\(^90\)

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In 2000 a skeptical journalist observed, “Quite frankly, a lot of us doubted this partnership would work… Well, it has worked, and extremely well.”

Clarence Ditlow of Ralph Nader’s Center for Auto Safety said that he and his organization had seen many environmental demonstration projects that had yielded little actual development. Regarding the development of more environmentally sound vehicles, he conceded in 1998, “There’s a sea change because up until now, the industry has said we can’t do it… Now the industry is saying we can do it.”

A final quotation on the change in attitude may effectively sum up these observations. In one interview, one industry participant observed, “Now it’s not ‘us and them’ – it’s how to get this done.”

**Changes in Specific Relationships**

The preceding sections have outlined changes in the overall relationship between government and industry. For greater appreciation of particular aspects of this relationship, this section explores the dynamics between the industry and distinct parts of the government. Specifically, this section discusses the relationships (a) at the technical level, among the scientists and engineers in government and industry, (b) between the auto industry and the White House, and (c) between the auto industry and regulators and legislators.

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91 Eisenstein, 2000, p. 89.
93 Interview with industry manager C, 1999.
Technical Interaction between Government and Industry

One area in which the cooperation appears to have excelled was in the technical interactions among PNGV participants. There are two reasons why the technical interaction may have been closer than other levels of interaction in the Partnership.

One is that technical interaction involved by definition engineers and scientists in similar or complementary fields – peers – who shared common professional and cultural ideals and characteristics. Beyond the settings of their respective employers, many were in the same professional societies and had the same interests – in some cases they may even have had more in common with their counterparts in other organizations than with their own coworkers.

Another reason is that this partnership was founded on technological problems and goals, and the very focus of its design was to encourage cooperation in the technical arenas. It is logical that, of all the levels of coordination, the interactions central to the Partnership – centered on developing and integrating technologies – would have to occur among the technical staff in government and industry.

One factor potentially working against this interaction, however, was the proprietary technical knowledge that each company maintains. Companies are guarded when interacting in advanced technical areas, especially if such knowledge could translate into appropriable advances in an area of increasing consumer demand. It is worth pondering whether the industry participants would have been more inclined to cooperate on technologies that had less consumer demand. If the increasing frequency of statements and advertisements regarding efficiency and emissions of their vehicles was
an indication, automakers appeared to recognize the potential for increased demand for such technologies.

Many participants noted that, prior to the Partnership, the lack of interaction permitted limited understanding among one sector for the motivations or perspectives of the other. As one industry participant said in an interview, “There was a lack of mutual understanding for both the technical folks of what the government was doing, and a profound lack of understanding of the government of the challenges the industry folks were faced with.”94

However, even the earliest interactions provided some new understanding. The same individual recalled, “In the initial meetings, we found 90 percent of the objectives were the same.”95

That is, the Partnership provided a means by which the industry and government could each understand the motives and intentions of the other and, once the Partnership was underway, demonstrate that they had many of the same objectives. Another industry participant noted a more specific mode of interaction: “We’re developing a common technical understanding. Early on, we built databases and analytical tools together.”96

On the government side, one of those interviewed agreed that the Partnership had early successes in these relationships: “Within the first year of the partnership, the

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94 Interview with industry manager E, 1999. Note that this statement was made long after the time in question.
95 Interview with industry manager E, 1999. Note that this statement was made long after the time in question.
96 Interview with industry manager C, 1999.
cooperative mode was far better than before. That’s certainly true at the tech level –
relationships that quickly developed are still in place.”

Another government representative interviewed noted how things improved with
industry buy-in: “Once it got going [with industry buy-in], … it was much easier for the
technical guys to talk to each other.”

Finally, in another interview, a government representative summarized the
benefits of interacting at the technical level: “We tapped into technical folks at industry,
as opposed to lobbyists. We wanted to solve a problem. Tapping into the technical folks
freed us up from a lot of bureaucracy.”

In July 1996, the Subcommittee on Energy and Environment of the House
Committee on Science held a hearing on the progress and goals of PNGV. By this time,
the Partnership had been underway for three years, during which time the technical
interactions among industry and government had begun to develop. At that hearing,
representatives from the Big Three provided a joint statement, which included the
following observation:

To facilitate government/industry cooperation, there have been numerous
reciprocal visits between industry R&D personnel and federal laboratories’
scientists. We also utilize workshops on special topics to bring together
researchers from the federal laboratories, universities, USCAR and existing and
potential new suppliers. These workshops and visits have fostered open
communication about research challenges and alternative approaches.

Site visits and workshops demonstrated willingness on the part of these
companies and laboratories to provide the types of interactions that could enable

97 Interview with government manager C, 1999. Note that this statement was made long after the time
in question.
98 Interview with government policy official E, 1999.
improved technical interactions. At the very least, it stands to reason that such visits would have helped each participant understand the other participants, both by increased interaction time, and by personally experiencing the settings and organizational priorities of other sites and organizations.

At the same Congressional hearing, Ford PNGV director Robert F. Mull noted, “We have been very pleased with the enthusiastic support for many dedicated technical personnel throughout the federal lab system.”101 This statement noted both that the federal laboratory personnel supported the Partnership, and that the industry representatives recognized this support.

Vice President Gore also noted the value of networking among the research staff at the technical level. Quoted in Newsweek in 1998, he said:

Some of the most valuable exchanges we have had through the Partnership have been not in formal settings, but in the informal receptions Tipper and I have held regularly in our home with members of the Partnership’s technical team. Researchers from the auto, aluminum, steel and oil industries and their spouses joined with government and academic scientists – many of whom had been working on the same issues for years, but had never met.102

While Vice President Gore would not have been closely involved in the more typical technical interactions, this quotation demonstrates his experience with casual interactions among technical staff and management among government, industry, and academia.

One benefit of interactions among technical staff across sectors is that they gain insights into the processes and goals of other participants. For example, an industry

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participant interviewed noted an increase in the mutual appreciation among the technical staff: “We now have a much better understanding of and appreciation for the expertise on both sides.” More specifically, this same individual felt the industry had acquired an improved understanding of what the labs have to offer: “The national labs are elite, capable, and generally outstanding. But industry at first didn’t understand how what [the labs] were doing could contribute to the effort. But now the auto companies have a much better appreciation of what goes on in the labs, and everyone can work together to mutually develop these vehicles.”

While that quotation shows an understanding of what the labs do and how they do it, the next, from another industry participant interviewed, shows that along with this understanding may come an understanding of what factors drive the work that goes on in the labs: “The cooperation allows our people to understand what government needs to do.”

Finally, the industry participants also used perhaps the most effective way of all to improve their understanding of federal goals, processes, and capabilities – they hired employees of agencies and labs: “Here’s one measure of how well PNGV is working. For [specific technology program of employer], we pulled much of our staff straight out of the labs. Now that’s knowledge transfer.” Not only did this individual demonstrate an appreciation for the transfer of knowledge and perspective from government and

102 Vice President Al Gore, “Finding a Third Way: Cleaner cars and a stronger economy: America can have both,” Newsweek, November 23, 1998, p. 58.
103 Interview with industry manager E, 1999.
104 Interview with industry manager E, 1999. Note that this statement was made long after the time in question.
105 Interview with industry technical staff A, near Detroit, Mich., November 17, 1998 (name withheld on request).
106 Interview with industry manager A, 1999.
industry, but he also used the example of hiring federal lab employees as a metric of PNGV effectiveness.

Industry participants also observed increased understanding in their counterparts in government labs. For example, one said, “The labs now appreciate what it takes to make profound technological changes happen [in vehicle technologies].”

Industry participants saw an increased appreciation for the challenges of implementing technological improvements in vehicles. Another noted, similarly, “PNGV has been extremely successful in cooperation in DOE, bringing real experience in making automobiles to the government researchers. That is important.”

Robert Mull, Ford PNGV director, also recognized the benefit of this effect on the understanding of the labs and of the agencies:

Much of our collaborative research is aligned with federal agency and lab missions, and we believe that exposure of lab personnel to our industry enhances the labs’ capabilities to accomplish their core missions… We feel that we have helped the government streamline its administrative processes and believe that as a result of the program, cooperation among the labs is improving.

As he noted the exposure of lab personnel to industry problems and processes, Mull also noted the effect of improved understanding and alignment on the cooperation among the federal labs.

Industry analysts also noticed the value of improved industry perspective for federal engineers. In a 1999 article Dunn explained, “[PNGV] gives the executive-branch scientists and engineers a valuable observation point from which to assess the

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107 Interview with industry manager E, 1999.
108 Interview with industry technical staff A, 1998.
progress of automotive research and development and judge what is technically feasible.”

This is not to say that there was a perfect understanding of technical challenges between industry and government. Recalling the expectations of working with the national labs, one industry participant described how some in industry anticipated (and encountered) difficulties working with the labs: “We knew how the National labs work – working with them would be very difficult. The trick would be to get good people. Labs have pressures to feed mouths… Most people working there have very, very wrong impressions about the auto industry, very one-dimensional image. We’d have to do an awful lot of work. And it’s still true.”

While noting some improvements in technical understanding, another industry participant identified room for improvement and that some problems persisted: “There is a great lack of understanding between science and technology. There is a huge hole in technology policy if there is a gap between what industry is doing and what government is doing… The notion of what an industry is is not well understood.”

A significant barrier was the distinction in the motivations between the government and the industry. As one industry participant phrased it, “For industry, the customers choose on a daily basis. The government is looking for long-term answers. Companies must keep their eyes open and use what they find, or someone else will.”

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111 Interview with industry manager A, 1999.
112 Interview with industry manager C, 1999.
113 Interview with industry manager A, 1999.
Most sources suggest that the industry and government appear to be working well together technically. A government representative interviewed observed, “The government and industry [participants] are much more of a team now.” 114

On the industry side, a joint statement issued by the Big Three in 1996 highlighted the increase in valuable relationships among technical staff in government and industry: “A number of valuable relationships between industry and government scientists have developed over the years, some pre-dating the formation of the PNGV program.” 115 This statement indicates that some of the relationships existed prior to the Partnership, but that others have developed since its inception.

An industry participant interviewed also pointed out that relationships were created and developed before and since the Partnership: “Over time, the relationships [among the industry participants] are improving – the individuals know each other better. But many knew each other before, too. And now they know government participants as well – at a technical level, at least.” 116 This same individual added, “Really, the PNGV tech teams are not different from any other cross-functional, cross-organizational teams.” 117

This statement suggests that the improved interactions were not surprising, implying that heterogeneous teams representing multiple organizations may be expected to similarly foster understanding and improved relationships across organizations.

114 Interview with government policy official A, Washington, D.C., November 2, 1999 (name withheld on request).
115 Chrysler Corporation, Ford Motor Company, and General Motors Corporation, written testimony submitted for U.S. House of Representatives, 1996, p. 71. Note that this statement was made long after the time in question.
116 Interview with industry technical staff H, 1998. Note that this statement was made long after the time in question.
However, that someone would even think of these teams – comprising individuals from Ford, GM, DaimlerChrysler, suppliers, DOE, EPA, and other agencies – as remotely similar to more mundane cross-organizational teams is in itself a statement of how routine these interactions were. It was not long before that many of these individuals would never have the occasion or opportunity to meet with these others.

While many pointed to the benefits of the relationships formed and strengthened by working together, some noted that the inter-organizational relationships created were dependent on specific relationships among individuals. Some expressed this as an added benefit, such as this government participant interviewed: “One lasting effect is that researchers know each other. PNGV or not, they’re not going anywhere – there may be some cross pollination as they keep talking to each other.”

Others, however, saw this as an indication of the potential fragility of some of the relationships. An industry representative interviewed noted this difficulty whenever new individuals join one of the technical teams: “You still see reluctance with new people. You waste 15 minutes in meetings just getting comfortable with each other.”

Having demonstrated that new technical interactions led to improved relationships among technical staff, we pause again to consider why this is important and what benefits there are in improved understanding.

In the fifth National Research Council peer review in 1999, the panel attributed much of the progress of the Partnership to the interactions of the PNGV technical teams:

117 Interview with industry technical staff H, 1998. Note that this statement was made long after the time in question.
118 Interview with government policy official B, 1999.
119 Interview with industry technical staff G, near Detroit, Mich., November 18, 1998 (name withheld on request).
In the past year, more progress was made towards meeting PNGV goals than in previous years of the program. In the view of the [peer review] committee, much of this progress can be attributed to the attitude and efforts of the PNGV technical teams, which appear to be working more cooperatively towards meeting common goals than in past years. The committee considers this to be a very positive change that has provided a needed boost to continuing technical productivity.120

This statement observed the ongoing cooperation on these teams, highlighting that this was a change that improved productivity, and that the attitudes and efforts of the technical teams were central to the progress made for the Partnership as a whole.

Stated a different way, one industry participant agreed in the effects on productivity: “We like to say that collaboration gets more done better quicker.”121

In 1999, Vice President Gore highlighted the work of the PNGV tech teams in a short press release: “I congratulate the technical teams from the automotive industry who continue to do what many said was impossible – establish an effective working team of talented scientists from the very different research cultures of government and industry... Working together they will literally change the world.”122

Industry Interactions with the White House

One specific dimension of the relationship between industry and government can be seen in industry’s attitudes towards and interaction with the White House. Without White House involvement, an interagency partnership of this scale could not have happened, and without continued White House support, the Partnership could not have been maintained in this form. While high-level federal staff were not involved at a technical or regulatory level, the agenda-setting abilities of the White House generally are

120 NRC, 1999, p. 2.
121 Interview with industry manager E, 1999.
central to other functions throughout the Executive Branch. In fact, to some extent, regulatory policies noted throughout this chapter reflect the larger White House agenda, whether through the specific attitudes towards the automotive industry or through the lack of any particular attention to the automotive industry.

Prior to the creation of PNGV, the antagonism commonly noted between government and industry was particularly strong between the White House and the industry. Whether a change was due to PNGV or not, some suggest that it came with President Clinton’s administration. As journalist Peter H. Stone stated in the *National Journal*, this antagonism continued through the administrations of Presidents Reagan and Bush: “The domestic auto industry often had rocky relations with the Reagan and Bush Administrations.”

Stone also quoted former Reagan administration official Clyde V. Prestowitz, Jr.: “The popular mind-set is that the Republican Party is more pro-business, but in the Reagan-Bush years, when the auto industry was in deep trouble, the attitude of the government was hostile… [The attitude of the Reagan administration was] to do nothing… [Today] there’s certainly a more cooperative effort on both sides.”

By this account from a Reagan administration official, there was a change in the level of cooperation from the prior Reagan or Bush administrations.

In *Automotive News*, Crain also noted, “Given the traditional Washington-Detroit relationship, improvement wasn’t really difficult. Clinton was preceded by 12 years of neglect in the name of laissez-faire capitalism. And Reagan-Bush were preceded by four

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123 Stone, 1994, p. 1176.
years of antagonistic over-regulation.”\textsuperscript{125} Crain said, in effect, that the cooperation proposed by the administration was an improvement over regulation and a laissez-faire approach.

Chapter 4 outlines the potential technological benefits of a concerted government-industry effort such as PNGV. Ignoring these benefits for the moment, some analysts have identified reasons why it was in the interest of the incoming Clinton administration to work with the auto industry. One analyst reported, “The administration, for its part, was eager for a less adversarial role with Detroit.”\textsuperscript{126}

Rob Chapman, one-time chairman of the government’s PNGV Technical Task Force offered more specific motivations: “A voluntary government-industry partnership had considerable appeal to the administration in that it avoided a confrontation with the Big Three, which constituted the largest industrial sector in the nation.”\textsuperscript{127}

Buntin provided further thoughts on the administration’s motives, noting that the industry also had reasons to consider cooperation:

Yet there were compelling reasons for both sides to avoid sliding back into their traditional roles as adversaries. After only narrowly managing to defeat legislation raising CAFE standards in the previous Congress, the auto industry felt uneasy about the prospect of another full-scale political fight... The new Clinton administration also had reasons for caution. With big plans to revamp the nation’s health care system, the administration was not eager to antagonize one of the nation’s largest employers.\textsuperscript{128}

Whatever the motivations, the changes were apparent to industry executives.

Some early periodical articles on PNGV included statements that indicate this awareness.

\textsuperscript{125} Crain, January 17, 1994, p. 12.
\textsuperscript{127} Chapman, 1998, p. 10.
\textsuperscript{128} Buntin, 1997, p.3. Note that this statement was made long after the time in question.
In 1993 Risen and Broder stated, “Industry executives say they are enjoying a level of cooperation from Washington on a wide range of issues…that they haven’t experienced in years, maybe decades.”\textsuperscript{129}

The authors then quoted Robert Liberatore, Chrysler’s vice president for Washington affairs: “This really is a new day, a new way for relations between Washington and Detroit.”\textsuperscript{130}

Similarly, Risen and Broder also quoted General Motors spokesman Pat Morrissey: “We have had a much more open dialogue with this Administration that with the previous ones.”\textsuperscript{131}

In another periodical article, Chrysler Corporation chairman Robert Eaton observed, “We had more input [with the White House] in one year than we had with the prior two administrations. We’re not expecting any windfalls, but we like to be heard.”\textsuperscript{132}

These changes in attitude and interaction between government and industry were also apparent to analysts of the time. Early in 1993, Crain said, optimistically, “It is increasingly clear that for Detroit, the new Clinton administration will be a far better listener than the previous administration.”\textsuperscript{133}

\textsuperscript{129} Risen and Broder, 1993, p. A18. Note that this statement was made long after the time in question.  
\textsuperscript{130} Quoted in Risen and Broder, 1993, p. A18.  
\textsuperscript{131} Quoted in Risen and Broder, 1993, p. A18. Note that this statement was made long after the time in question.  
\textsuperscript{132} Quoted in Crain, January 17, 1994, p. 41. Note that this statement was made long after the time in question.  
\textsuperscript{133} Keith Crain, “Good signs or bad?” \textit{Automotive News}, January 18, 1993, p. 12. Note that this statement was made long after the time in question.
One year later, Crain could confirm what he had claimed: “The White House now talks to the Big 3 – and does something about what it hears.”

After several years, participants and outside analysts still reflect on the changes since the days before the Clinton administration. In 1999 Brooke described how things had changed for the Clinton-Gore team from the start of their administration:

The policy-watchers agree that Gore’s thinking has evolved since taking his job in ’93. Then Clinton and Gore staffed up the White House with people who wanted to improve the environment only through regulation… Al Gore may not be the regulatory bogeyman he was made out to be a few years ago, yet it’s tough finding a policy-watcher who’s outright bullish on prospects of a Gore Administration. Still most believe he’s a man the industry can do business with.

Stakeholders in the Partnership agree that White House attitudes had changed. Brenda Day, DaimlerChrysler’s director of Congressional affairs noted, “I think the PNGV program has been a good educator for both Al Gore and the car companies… It’s proven he can be pragmatic, pushing technologies but realizing the way to do it is through cooperative research rather than regulation.”

Al Slechter, DaimlerChrysler’s director of regulatory affairs added, “I think Gore’s learned in the last six years that the industry’s got a lot to offer.”

Finally, Bill Rosenberg, an EPA clean air Administrator under George H. W. Bush, observed that Vice President Gore has been “out there working for government-industry cooperation, talking to people.”

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135 Lindsay Brooke, *Automotive Industries*, January, 1999, p. 29. Note that this statement was made long after the time in question.
136 Quoted in Brooke, 1999, p. 27.
137 Quoted in Brooke, 1999, p. 29. Note that this statement was made long after the time in question.
138 Quoted in Brooke, 1999, p. 29.
Industry Interactions with Regulators and Legislators

When the industry or the media refer to the government – particularly in the context of the antagonistic relationship between government and industry – often they are referring to government regulators. This is understandable, as from the industry’s perspective, this role of the government is conspicuous in its ability to limit or direct the actions of the industry.

However, when people make statements referring to regulators, it is not always clear whether they mean to refer to legislators or regulators in agencies, both of which have roles in regulation affecting the auto industry. For example, there are agencies that have regulatory roles, such as the Environmental Protection Agency (e.g., emissions standards) and the Department of Transportation (e.g., CAFE standards).

On the legislative side, Congress has multiple roles in the regulatory process. First, it can set standards directly through legislation, as it did, for example, in setting air quality standards in the Clean Air Act and its amendments. Congress can also authorize executive agencies to perform regulatory functions. In addition, Congressional appropriators can play a more active role in agency-based regulations, by using provisions in appropriations that limit or prevent agency funds from being spent towards enforcing specific regulations. This was the case with CAFE standards during the 1990s.

In a previous section, this chapter notes different perspectives on the regulatory battle that some perceive between the government and the auto industry. Some saw the industry dragging its heels and claiming change is difficult, and others noted practical reasons that make the industry only appear to be uncooperative. One industry participant characterized the standard interaction with regulators as difficult: “[In] EPA rulemaking,
highly polarized points of views are brought out. It’s quiet in the middle.” With the
typical regulatory relationship the auto makers were used to, any conversation would
have seen little compromise, as the regulating body and the regulated company could
each only see and state their own viewpoints.

Interviews with participants and quotations in periodicals point to this problem as
a motivation for aspects of the Partnership. In 1995, Tim Adams, at the time the PNGV
director from Chrysler, suggests this motivation in the following quotation:

PNGV represents the opportunity to more efficiently address fundamental
national objectives than the regulatory mandate approach that we have taken
before… We’re going to create market drivers to get people to act in ways
consistent with national objectives… That’s instead of distorting the market by
forcing people to do things that they really don’t want to do. That’s powerfully
attractive.

That is, Mr. Adams was looking forward to the use of federal policies other than
mandates to achieve national objectives. Regarding his concern for getting “people to act
in ways consistent with national objectives,” it is not completely clear from the context of
this quotation to whom he referred (e.g., industry or the consumer). What is clear is that
Mr. Adams was talking about replacing “sticks” of mandates and penalties with “carrots”
that would have motivated people to through market mechanisms.

More fundamentally, PNGV permitted a clear, simplified node that industry could
use to discuss (if not work to align) agency policies and regulations. In a 1998 interview,
John H. Gibbons, who had just retired from his position as President Clinton’s science
advisor, said: “If you look into this program [PNGV] from the industry side, say you are
General Motors, you see one place where you can go in dealing with the Executive

139 Interview with industry manager D, 1999.
140 Quoted in Keebler, 1995, p. 36.
Branch. You can go to the Under-Secretary (Technology) of the Department of Commerce and it is there that all seven of these agencies come together and work as a virtual, single, one-stop shop for the federal government.”

On the government side, the White House was not alone in seeking a change from the status quo. In a 1994 hearing, Representative Tim Valentine (D-North Carolina), the chairman of the Subcommittee on Technology, Environment and Aviation, of the House Committee on Science, Space, and Technology, recalled the relationship between government and industry: “A somewhat adversarial relationship has developed between the Government and the [automobile] industry, with regulatory and legislative actions affecting the design and the cost of the final product.”

As chairman of this particular House subcommittee, Congressman Valentine was in a good position to comment on the adversarial relationship on regulatory and legislative matters. He continued, “A new way of thinking about the auto and the auto industry has been necessary for some time, we believe.”

At another hearing for the House Science Committee, the Big Three issued a joint statement on the promise for the Partnership in government and industry cooperating in such matters:

PNGV is a research program and is not tied to the regulatory process. It does, however, represent a new paradigm for government and industry to jointly tackle problems of common interest through cooperation and mutual trust. This program represents an important precedent for a ‘new way of doing business’ between industry and government – a quicker, more efficient, and more effective way of

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reaching societal goals than the adversarial and costly regulatory mechanisms relied on traditionally.\textsuperscript{144}

The Big Three had clear motivations to want something other than the relationship of the past. Some critics say it is no surprise that industry would want to avoid the increased cost and effort that regulations often bring. Regardless of whether such cynicism has merit, the pace and often conflicting requirements of regulation make it difficult for industry to comply.

Part of the difficulty is that industry must respond to regulations that change faster than production cycles. Cars are designed and produced on cycles that take from four to six years, but regulations can change or become stricter on a yearly basis. True, regulators often build in lags prior to the effect of the regulation, but manufacturers sometimes argue that those lags are inadequate to account for the necessary technical changes. Speaking on the challenge of meeting changing regulations despite development cycles of four or more years, one industry representative suggested this metaphor: “It’s like bird hunting. You’ve got to shoot where the bird’s going to be.”\textsuperscript{145}

Also, as previously discussed, a lack of harmony of rules and regulations among federal agencies, between federal and state agencies, and across countries, makes it difficult for automakers to respond quickly and effectively. At the federal level alone, regulations on automobiles may originate with Congress, the Department of Transportation, the Environmental Protection Agency, or other agencies. In addition to these, there are requirements and mandates imposed at the state level – perhaps most notably by the California Air Resources Board.

Beyond those, of course, are the entirely different – and often conflicting – requirements that governments of other countries impose. While to some extent the industry in each region of the world has its own infrastructure and distribution of vehicle demand and supply, the R&D systems and infrastructure needed to support the diverse needs of world markets can be staggering.

To summarize, increased costs of research and production to meet new regulations are a common reason for industry resistance. However, the industry also faces fundamental practical difficulties in meeting multiple, rapidly changing, and at times conflicting regulations. Evidence for change in the relationship between industry and legislators was not common, but it was fairly consistent. As an example, Senator Richard H. Bryan (D-Nevada), who had pushed for higher fuel-efficiency standards, observed in 1994, “Clearly the [current leaders of the] Big Three are less confrontational than their predecessors… I think they’ve crossed a philosophical divide that they’ll have to engage in a dialogue with the government.”146

Industry analyst James Dunn Jr. noted the benefits to both sides of the partnership in regulatory issues:

In regulatory policy, the partnership approach has important political advantages for both sides. It enables the administration to tell environmentalists that something is being done about auto-related energy and pollution problems. It finesses a confrontation with Congress over whether to impose new federal regulations on the auto industry… For Detroit, the PNGV promised a 10-year breathing spell during which it could continue to market its profitable lines of sport utility vehicles without having to worry about their impact on the auto manufacturers’ CAFE conformance.147

145 Interview with industry manager C, 1999.
146 Quoted in Stone, 1994, p. 1176. Note that this statement was made long after the time in question.
147 Dunn, 1999, p. 96.
These benefits appear to be confirmed by industry participants. Elliott S. Hall, Ford vice president for Washington affairs noted the access industry had gained to key research, trade, and regulatory agencies: “We have unprecedented access to all the Cabinet positions that relate to the auto industry-Treasury, Commerce, Labor, Transportation, and USTR [the U.S. Trade Representative’s Office]”.  

In 2000 Jim Holden, at the time head of DaimlerChrysler North America, related similar benefits directly to the strength of the relationship: “The relationship between industry and government is getting better. PNGV has been a success, [even though] we don’t have a marketable vehicle. We’re not as combative as we once were with NHTSA and the EPA.”  

This change was due in part to a renewed willingness to work with the regulators to convey difficulties in potential solutions, and find solutions that could translate into improvements without imposing avoidable burdens on the automakers. “The auto industry has finally wised up in Washington. Instead of publicly resisting tougher clean-air rules, the companies are cooperating with the EPA… Working cooperatively will build the industry’s credibility – and produce the best deal in the long run for everyone.”  

Speaking on the subject of working with regulators, General Motors’ PNGV director Ronald York noted that these changes have extended to the attitudes of those in government and industry: “It’s been great to be able to go in with recommendations and see people attempt to implement them rather than [to try] to figure out how to get rid of

149 Quoted in Michael Woodyard, “Incentives: At times, ‘enough is enough,’” Automotive News, May 8, 2000, p. 40. Note that this statement was made long after the time in question.
them… Industry and government have learned to collaborate in an effective and responsible way on something of great significance to the country.”151

In interviews, industry representatives explained how they interacted with staff from regulatory agencies: “[Industry representatives have] weekly meetings with regulatory staff, to answer questions that come up. A recurring question is what regulations would have to change with the changes in technology we’re looking at. We’re working on that.”152

One industry representative commented that the partnership can get into regulatory issues and that working together provides new ways of solving problems: “[The team approach leads to] better understanding, which lets us invent or find approaches to a problem and come up with a solution.”153 The speaker implies that the cooperation helps regulators understand the technologies, and it also helps engineers understand regulatory concerns. The individual continued, “Regulatory approaches can impact each other, since safety, emissions, and CAFE regulations are all moving targets… A systems solution to do these things would be more helpful.”154

Another industry representative noted that forming a trusting relationship with regulators was difficult, but worthwhile: “It’s taken longer to find a good match of people. Trust is a big issue. Having EPA as a partner is strenuous for us. But with this

152 Interview with industry manager D, 1999.
153 Interview with industry manager D, 1999.
154 Interview with industry manager D, 1999.
mix of unique personalities there is trust.”155 Chapter 10 provides a more in-depth discussion of the issue of trust.

Regarding how PNGV has affected this struggle in the regulatory arena, industry analysts suggest a positive influence. In an earlier summary of the partnership from 1996, Daniel Sperling expressed some skepticism concerning some of the benefits of the partnership. Nevertheless, he acknowledged the effect on the government-industry relationship:

Inspired by the Japanese model, [both government and industry] were seeking to transform a contentious regulatory relationship into a productive partnership. The Partnership for a New Generation of Vehicles (PNGV), as it became known, has borne some fruit: it has raised the profile of vehicle technology R&D efforts and, as a result of increased communication and coordination, eased the adversarial relationship between automakers and regulators.156

Sperling’s otherwise critical assessment of the partnership adds credibility to this particular observation.

In a Scientific American article from 1999, Sperling again noted the benefits outside the technical arena. He quoted Ford PNGV director Vincent Fazio as saying that the program has been instrumental in fostering “a significant amount of trust between Washington regulators and the industry.”157

In the same article, Sperling also quoted Steven Zimmer of DaimlerChrysler, who credited the representation of regulatory bodies such as the EPA in the partnership for “an

155 Interview with industry technical staff F, near Detroit, Mich., November 18, 1998 (name withheld on request).
156 Sperling, 1996a. He makes a similar statement in Sperling, 1996b, p. 30. Note that this statement was made long after the time in question.
157 Quoted in Glenn Zorpette, “Waiting for the Supercar: Overly ambitious goals may have hurt the Partnership for a New Generation of Vehicles,” Scientific American, April 1999, p. 47.
This positive effect appears to be true with respect to both government and industry. In a 1996 *Automotive News* article, Crain stated:

Remember the poke-em-in-the-eye/keep-their-feet-to-the-fire relationship between Congress and the U.S. auto industry a few years ago? It is gratifying to see that it has changed for the better, thanks to a little common sense and a little patience… The industry no longer screams, ‘It can’t be done’ before it hears what Congress wants. Congress no longer accuses the industry of subterfuge before hearing the automakers’ position… The industry’s game plan seems to be working in the nation’s capital.\footnote{Keith Crain, “Today's rapport with Washington pays off for Big 3,” *Automotive News*, September 23, 1996, p. 12. Note that this statement was made long after the time in question.}

While not directly relevant, it is worth mentioning the shift in the automakers’ attitudes towards safety-related regulation. The struggle for safety has been a longstanding symbol of the automakers’ resistance to government regulation. Beginning with the debate following Ralph Nader’s book *Unsafe at Any Speed*, automakers have been characterized as doing whatever they could to resist any additional regulations they face. Crain noted how things have changed recently: “The days when the government had to prod lethargic automakers to make safer vehicles are long gone. Now, the government can’t write regulations fast enough to keep up with advances in safety technology. Automakers – and their suppliers – have become the champions of safety and they must continue the momentum, now that consumers expect it.”\footnote{Keith Crain, “Safety sells; makers in lead—it's a new era,” *Automotive News*, March 13, 2000, p. 12. Note that this statement was made long after the time in question.}

The change in question was due to rise in consumer demand for automotive safety features. While efficiency or emissions characteristics did not yet hold the same

\footnote{Quoted in Zorpette, 1999, p. 47.}
consumer priority, there is evidence that that too was changing, or at least that the car companies were anticipating that change in making hybrid vehicles available to the public.

Ford Chief Executive Officer Alex Trotman summed up the new climate of cooperation: “I would say over the last four years, the industry has done very well. I think we have had a very good ear, both in Congress and in the administration. The environment has been very positive [and there is] an interest in the problems of our industry.”161

Obstacles and Challenges

Among these successes, there are persistent tensions between the government and industry partners. To some extent, such tensions are to be expected when partners have different motivations, cultures, and expectations. Further, the types of resources government and industry bring to the table are different, yielding a continuing asymmetry in the value of each partner’s contribution. For example, the government tends to fund more basic research, while the industry funds research and development towards specific technologies and business lines. While government and industry participants in PNGV have agreements for sharing research costs, distinct types of research make it difficult for the partners to agree on what constitutes comparable types of investment.

In the 1994 hearing on PNGV, Ford representative Robert F. Mull noted, “As for our working relationship with the government, we’ve had mixed experiences… The complexities of dealing with the federal government are a continuing challenge. While

the relationship is not perfect, we are working hard and we are continuously improving, and we believe overall the relationship is working.”

Industry long complained that the federal funding for the partnership was disappointing or inadequate. As cost-sharing required industry to match federal funds or be a certain share of the total, industry repeatedly objected to what the government counted as part of the partnership. As one industry representative noted, “We don’t always agree with what the government adds up.”

Another industry representative complained: “Originally, DOE just relabeled their ongoing efforts.” If ongoing, irrelevant efforts were included in the government side, industry shouldn’t have to match those costs, they argued.

Other industry representatives were similarly unimpressed by the government’s perspective on cost sharing. One said, “There’s a higher contribution from the industry side than from government. Industry is pulling the collaborative share; industry is doing the PNGV work.” This same individual continued: “We’re doing more than we’re getting credit for, which is relevant in matching. It would be great if we could remove the one-to-one program matching – industry participation is limited by the need for matching. It’s a continuing issue.”

Furthermore, industry representatives also noted that they had little access to certain activities the government was counting as part of the partnership, particularly at agencies other than DOE. Industry pushed to include in the crosscut of relevant federal

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163 Interview with industry technical staff A, 1998.
164 Interview with industry manager B, near Detroit, Mich., December 14, 1999 (name withheld on request). Note that this statement was made long after the time in question.
165 Interview with industry technical staff H, 1998.
activities only those activities that they could directly influence or benefit from. While
the scorekeeping of activities became an ongoing debate, the government’s 1996
establishment of a chief financial officer for the partnership at the Office of Management
and Budget helped provide more thorough and consistent scoring.167

Another area of frustration for industry was what they saw as government
bureaucracy. Many industry participants interviewed noted that the process was slow and
cumbersome. One said, “I’m disappointed but not necessarily surprised at the difficulty
of the government funding process and contract administration process.”168

Another complained, “The process is cumbersome – it has caused some OEMs
and suppliers to not even participate.”169

A third summarized, “Government funding is limited by red tape, time-consuming
calls for proposals… For the most part, the auto companies haven’t been in the business
of dealing with government funding and contracts.”170

Some frustrated by the process were more specific to the red tape involved in
working with the federal labs. Richard Marczewski, a General Motors liaison for
government labs, noted that the establishment of USCAR required 15 separate CRADA
agreements. He added: “The CRADA process at DOE sucks… It took 18 months… It
was a real bear.”171

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166 Interview with industry technical staff H, 1998.
168 Interview with industry manager C, 1999.
169 Interview with industry manager C, 1999.
170 Interview with industry technical staff H, 1998.
171 Quoted in “Rocky road for federal research inc,” Science, Vol. 262, Issue 5133, October 22, 1993,
p. 496.
Other industry representatives interviewed appeared to agree. One explained, “It’s a long time coming to influence what the labs do.”\(^{172}\)

Another said, “Government can only do high-risk research – by the time the government goes close in, it’s too late.”\(^ {173}\)

Some from industry agreed that the government bureaucracy was a problem, but they also noted that the problem was also the addition of that layer to the existing corporate bureaucracies. A 1997 article in *Federal Technology Report* related statements of a Ford Motor Company executive:

Bill Powers, vice president for R&D at Ford Motor Co., said government red tape has complicated efforts by the domestic auto makers to arrange corporate R&D agreements with government labs under PNGV, although he added that delays ‘often are our fault.’ Powers also called for better integration of activities among federal agencies and DOE labs involved in PNGV.\(^ {174}\)

An industry representative interviewed agreed:

Government is more restrictive in procurement. The differences add up – they take their toll in time and progress. With three companies plus the government, it’s like working through four bureaucracies… In negotiations and approvals, much is out of your control. The government focuses on fairness of procurement. Industry’s guiding principle is the objective of hardware.\(^ {175}\)

This statement highlights not only the effects of multiple bureaucracies, but also the more specific differences in the criteria each of the partners try to meet through their work.

Industry participants were also disappointed by what they saw as missed opportunities. Some lament the limited roles of agencies other than the Department of Energy. Congressional testimony the Big Three provided in 1996 included the following:

\(^ {172}\) Interview with industry manager B, 1999.
\(^ {173}\) Interview with industry manager C, 1999.
However, there are opportunities for strategic leveraging that are being missed and some existing relationships are at risk. A common misconception is that PNGV would divert resources away from agency missions. We have been working consistently to correct these misunderstandings and to identify technical program alignments that produce mutual benefits. In addition, important existing programs are in danger of being cut off prematurely because of both fiscal and policy constraints.\textsuperscript{176}

This sentiment was echoed in several interviews with industry representatives of the partnership. For example, one industry representative expressed disappointment that more agencies were not involved: “There are more government programs out there that are not considered to be part of PNGV.”\textsuperscript{177}

Others had more to say about the limited participation of agencies other than DOE who were also participating: “DOE is really the only agency at the table that is making meaningful contributions.”\textsuperscript{178}

Another observed, “DOE is the core of the effort. The contribution from others is minimal.”\textsuperscript{179}

A third complained, “We really only have a couple of agencies on board… All of the agencies that signed up originally are logical participants.”\textsuperscript{180}

One government representative agreed, suggesting one indicator for the problems in bringing agency resources to bear: “One piece missing is senior political accountability. When it comes to a picture-taking opportunity with the [Vice President], they all show up. But when it comes to the rubber meeting the road, really only three

\textsuperscript{175} Interview with industry technical staff D, 1998.
\textsuperscript{177} Interview with industry technical staff H, 1998.
\textsuperscript{178} Interview with industry manager A, 1999.
\textsuperscript{179} Interview with industry technical staff A, 1998.
agencies are significantly involved: EPA, DOE, and DOC.”\textsuperscript{181} Clearly, the extent to which an agency will participate in a partnership has to do with the alignment of its mission with the partnership. Industry partners should not expect all agencies to be able to participate. At the same time, agencies and the White House should probably be careful to set expectations appropriately.

On the government side, one federal manager was disappointed that the government did not manage the partnership much more tightly, nor did it reshape organizations and resources as much as it could have: “The management was fairly loose. I wouldn’t run it the way it was run. It would be better with more checks and balances; while it is effective now, we could have done even more. It was very difficult to direct. The authority did not go with the resources.”\textsuperscript{182} However, while more dramatic reorganization might have made PNGV more effective in some ways, some argue that a higher profile or more centralized partnership could have provided a more distinct target to opponents of the partnership in Congress and elsewhere.

Finally, a relatively late development in the regulatory arena was the EPA’s announcement of Tier II regulations, which set new vehicle emissions standards. This was seen by many in industry as a shift back to conflicting federal policies. One industry representative noted:

\begin{quote}
In our minds, we’ve been screwed by Tier II. EPA is focused on cleanliness, while we’re focused on national fuel economy (which is synonymous with CO\textsubscript{2}). Historically, we have been able to balance clean with efficient … in order to meet certain standards, now we must run lean, and the efficiency of the NO\textsubscript{X} catalyst goes to hell… Gore had set what everyone thought were ambitious research goals on particulates and NO\textsubscript{X}, which PNGV had been using. Having to deal with Tier...
\end{quote}

\textsuperscript{180} Interview with industry technical staff A, 1998.
\textsuperscript{181} Interview with government manager B, 1999.
\textsuperscript{182} Interview with government manager D, 1999.
II has really slowed down the partnership. The amount of energy required has taken key people off the program… Plus, not only is the standard technically challenging, but it is incredibly marginal, and the benefit is very small.\(^\text{183}\)

The same speaker continued with one positive aspect of the interaction: “But there has been a success in this area… We had recommended a sulfur standard on fuel [which the EPA acted on]… Going to low sulfur at the pump affects every car on the road.”\(^\text{184}\)

The shift in Tier II standards may have posed a shift in the negotiated constraints of the partnership. Diesel-hybrid designs intended to meet the 80-MPG goal suddenly faced more difficult barriers. At the very least, the shift in relevant regulations gave the industry participants something to blame if they cannot ultimately meet the PNGV goals.

**Conclusions**

The citations in this chapter demonstrate a relatively consistent message across participant and stakeholder groups and at all levels of staff. While it is impossible to compare everything that appears to have happened with PNGV to what might have happened without it, it is clear that PNGV appears to most observers to have been central to strengthening the government-industry relationship in this area.

This chapter identifies a number of benefits of the government-industry cooperation implemented through PNGV, including: identification and articulation of common goals; consideration if not alignment of relevant policies and regulations across agencies, and simplification of the executive branch interface for the automotive industry.

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\(^{183}\) Interview with industry manager B, 1999.

\(^{184}\) Interview with industry manager B, 1999.
Two final quotations for the chapter summarize these findings well. Gary R. Bachula, the acting Under Secretary for Technology at the Department of Commerce, noted in an address:

In the past, government’s relationship with industry was often defined in the regulatory arena – in the school principal’s office, so to speak – and that created an atmosphere of discord rather than cooperation. And, perhaps, there was once a time we as a nation could afford that. Those days are over… The industry is breaking new ground in the way it works with government. This Administration is committed to the path of partnership as a way to ensure that the American auto industry’s legacy of success extends into the next century.185

Mr. Bachula suggested than the nation can no longer afford the long-standing antagonism between government and the auto industry, implying it was not productive.

An industry representative interviewed made similar comments:

How did PNGV transform a very adverse relationship [between government and industry] into something different? … First, there was the realization that [the government] needed a new way to attack problems – economic and others. Problems like defense, environment, and health. And we needed to evolve a uniquely American approach.186

While these quotations essentially agree on the overall effect of the partnership for the outlook for a productive relationship, they don’t quite agree on what they credit for the shift. Somewhat remarkably, Mr. Bachula, representing the government, credited the industry with making headway, saying that the administration was committed to seeing it through. Conversely, the industry representative primarily credited the government’s approach through PNGV with moving beyond the preexisting adverse relationship. While other quotations available from these stakeholder groups would not necessarily agree on where the credit belongs, this juxtaposition is interesting in showing

that speakers from both the government and industry sectors independently give most of
the credit to the other sector. This contrast may simply indicate each sector’s awareness
of the other sector’s difficulties and barriers. Nevertheless, the fact remains that each
side recognizes the progress the other side has made in overcoming or eliminating
barriers. And this acknowledgement of progress is itself a sign of positive attitudes and
goodwill between government and industry.

http://www.ta.doc.gov/Speeches/Alumin.htm (Note that this statement was made long after the time in
question.)

186 Interview with industry manager C, 1999.
CHAPTER 9: RELATIONSHIPS WITHIN THE DOMESTIC AUTO INDUSTRY

Much in the same way PNGV contributed to improvements in the relationship between government and industry, it also yielded similar improvements in the relationships among the companies in the auto industry. These industry relationships are a part of the larger government-industry relationship discussed in the last chapter, and in many ways, this chapter is a more narrowly focused case of the previous chapter.¹

While the change in the relationship between government and industry demonstrated in Chapter 8 was a fundamental motivation for PNGV, demonstrating similar improvements in the relationships among industry participants was never a primary PNGV goal. However, improvements in the relationships within industry can be important, for at least three reasons. First, willingness to cooperate is a necessary condition for a partnership to work. It is difficult to have a constructive, productive partnership without communication, coordination, and other characteristics of a good relationship. This is true not only between government and industry, but also within the industry. If the Big Three were not joined in a productive partnership, it is difficult to see how they could collaborate meaningfully, or in any lasting way. Being able to demonstrate a productive relationship indicates that the larger partnership was possible and that the apparent cooperation was meaningful.

In addition, there was also the hope for a lasting effect of PNGV. Regardless of whether the government and industry relationship would last, if the industry participants

¹ This chapter focuses primarily on relationships between OEMs, but some industry relationships also include companies that supply parts, expertise, and processes for the OEMs.
found something useful in the cooperation, the relationships and lessons could endure. Given the competitiveness motivation of PNGV to strengthen the domestic automotive industry, the partnership model may have helped to do this in part by strengthening existing channels within the industry, creating new ones, and encouraging participants to conceive of new types of arrangements with existing and new partners.

Finally, in addition to increasing the level of interaction among OEMs beyond the levels already established through existing consortia and USCAR, the partnership’s concrete, publicized national goals (especially to the extend they were motivated by national competitiveness) provided a much greater focus and level of joint responsibility. The results of the efforts of the OEMs would be judged not only by their respective commercial successes, but also by the extent to which each could address these goals.

This chapter examines industry relationships using an approach similar to that of the last chapter. It starts with a historical look at the industry side of the partnership and demonstrates apparent changes in the relationship. A discussion of the apparent changes is followed by a discussion of attribution. This chapter includes a short section on changes in specific industry relationships. The analysis shows that the relationships within the domestic industry participants in the partnership improved during its term, though the specific role of PNGV in improving relationships is difficult to establish.

The chapter concludes by exploring certain obstacles and challenges that industry relationships face, in part due to the balance between competition and cooperation. These issues are further discussed in the next chapter, which expands on specific components of the relationships that assisted the cooperation or changed as a result of it.
Notes on the Hypothesis and Supporting Data

Demonstrating changes in relationships among companies can be even more difficult than the same assessment between government and industry. Periodicals discussing the auto industry appear to address interactions and attitudes among the companies only rarely. Consequently, interviews are the primary source of evidence for this hypothesis. The interviews focus on attitudes of individuals, while, to the extent possible, this assessment uses secondary sources to help illustrate shifts in attitudes among the companies.

As in the last chapter, discerning causality is problematic. When we demonstrate some condition, it is still difficult to say it is the result of a policy intervention (i.e., PNGV), as opposed to an unrelated result of the same conditions that motivated the policy, or a simple coincidence.

Since the relationships within industry formed a subset of the larger government-industry relationship, it follows that some of the shifts in cooperation demonstrated in the last chapter also reflect well on relationships within the industry. For example, some interviewees mention improvements in both types of relationship explicitly, while others make more ambiguous references to, for example, relationships among partners. Sources that explicitly commented on both types of relationship are cited in both chapters, but sources that were more ambiguous in stating the particular partners or interactions are cited in the previous chapter only.

A Changing Relationship within the Auto Industry

The following sections chronicle the progress in the relationship among industry OEMs from the time before the partnership. The structure of these sections and the
associated quotations are mostly chronological with respect to the time period being discussed, if not with respect to the date of the source itself. The first section discusses previous characteristics of the relationships, while the second discusses the legal and organizational changes that preceded (and enabled) PNGV. The third section introduces the effect of PNGV. Two final sections identify other evidence for success and assess the attribution of improvements to the partnership itself.

An Adversarial Relationship

The last chapter discussed the traditional antagonism between the government and the auto industry. There was also antagonism among the automakers, but, instead of regulatory antagonism, the antagonism stems from the longstanding competition among the rivals. As one industry participant noted, “[Prior to PNGV,] any conversation was a negotiation – a win-lose game. Both between companies and between industry and the government.”

In addition to competitive rivalry, structural and cultural differences among the Big Three make it more difficult to see eye to eye. At the same time, they have much more in common with one another than they do with automakers in other countries. They are located in similar areas, they faced similar regulatory challenges in the past, they faced similar threats from foreign competition, and they share labor unions and other associations.

2 Interview with industry manager D, 1999. Note that this statement was made long after the time in question.
3 While the Big Three can be still compared and contrasted with other OEMs, it is becoming increasingly difficult to make such generalizations, as all of the OEMs have evolved different structures, geographic distributions, and linkages, through various expansions and mergers.
Consortia, USCAR, and Renewed Government Interest

PNGV can’t accept all of the credit for bringing the OEMs together. Consortia such as USABC and the coordinating framework of USCAR pre-dated PNGV. Not long before, antitrust laws prohibited significant cooperation among companies. As industry analyst Keith Crain observed, “Only in recent years have the Big 3 been able even to talk together.”

A 1992 article from *The Economist* characterized this effect well:

Just five years ago, the top managers of Detroit's "big three" car makers studiously avoided meeting each other for fear of incurring the wrath of America's antitrust authorities. How times have changed. On June 8th officials from General Motors (GM), Ford and Chrysler got together to launch the United States Council for Automotive Research (USCAR) to co-ordinate their growing list of joint R&D projects. In days of yore these companies were fierce competitors. Today they seem much more comfortable acting as collaborators.

Once such collaboration was illegal. Suspecting that, given half a chance, Detroit's big three would rig the market, or delay the introduction of new technologies, the American government made them consent to a court decree in the 1960s which barred them from pursuing any joint R&D projects. Since then Japanese competitors have grabbed 25% of the American car market. And over the past decade America's antitrust rules have been relaxed.

In 1987 the court decree barring joint R&D expired. The following year GM, Ford and Chrysler set up their first joint venture to investigate the use of composite materials to replace metal in cars. Since then, they have embraced the idea of joint research with all the excitement of a teenager driving his first jalopy.

With the election and inauguration of President Clinton, the automotive press noted new possibilities for collaboration among the automakers. It was not long after the election that the President and Vice President were talking with executives from the Big Three. In the six-month period from December 1992 to June 1993, Keith Crain provided

several relevant observations in his weekly *Automotive News* editorial. First, following
the election, Crain reflected, “There is some speculation in Detroit that the Big 3 might
have an opportunity to jointly develop an electric vehicle… Cooperation makes sense for
the future. The government will have to change some laws to get the job done. The
Clinton administration should begin immediately.”6

Crain saw possibilities for industry cooperation on an electric vehicle
(presumably, it was the same talk that led to PNGV). As the inauguration neared, he
observed, “Meanwhile, we will inaugurate a new president this week, and the big 3 are
demonstrating a new-found congeniality I have never seen before. Not only are they
starting to talk about cooperation, but they seem to be doing something about it at the
same time.”7 Here, Crain could already perceive a new attitude and new actions among
the automakers that could hint at more productive research cooperation.

Months later, as if to confirm his speculation, Crain suggested: “The Big 3 are off
to a great start on joint research.”8 The following week, he added: “The domestic
automobile producers are cooperatively making great headway today on a whole raft of
ideas and challenges. They’re cooperating in so many areas that they have created an
organization that will do nothing but coordinate the joint research activities.”9 Together,
these quotations over this six-month period show a gradual progression of apparent
willingness to cooperate among the automakers.

Near the same time as the last quotation, one analyst noted some examples of how
the car makers were cooperating under USCAR and the new White House leadership:

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7 Crain, January 18, 1993, p. 12.
8 Crain, June 8, 1992, p. 12.
“They are now collaborating on computer-aided design, recycling and advanced batteries. Together with the launching of USCAR, they unveiled their eighth joint project, an effort to find ways to reduce exhaust emissions.”\textsuperscript{10} That this analysis came from an article entitled “America's Car Makers: Lovey Dovey” further underscores the new, more positive, attitude.

**PNGV and Its Effects**

The announcement of PNGV formalized the government-industry relationship and gave the industry consortia and cooperative a much higher public profile.\textsuperscript{11} Some changes were quickly apparent. One federal lab employee articulated the difference between the old and new attitudes within the industry, due to the combination of USCAR and PNGV: “Before, we couldn’t work with any two of the automakers at the same time. Now, we don’t have to pussyfoot around.”\textsuperscript{12}

Several years into the partnership, participants interviewed noted many changes in their interactions with one another. An industry representative later interviewed was more explicit in attributing the communications among the automakers to the partnership: “As a result of PNGV, companies are talking to each other more.”\textsuperscript{13} In this quotation, this individual not only noted the change but also clearly gave the credit to the partnership.

\textsuperscript{10} “America's Car Makers: Lovey Dovey,” *The Economist*, June 13, 1992, p. 77.
\textsuperscript{11} See Chapter 3 for an outline of the events involved in launching the cooperation, as well as the larger outcomes of the partnership.
\textsuperscript{12} Bill Robinson head of the Automotive Programs Department at Sandia, as quoted in Max Gates, “Big 3 tighten federal lab ties,” *Automotive News*, October 25, 1993. p. 24.
\textsuperscript{13} Interview with industry technical staff C, 1998. This quotation also appears in Chapter 8.
In response to a question on the impact of PNGV, another industry participant interviewed provided more details of the improvement: “Among the industry, the interaction has become much better – a freer flow. Between ’93 and ’94 the rapport improved. Still there are positioning problems and continuing reluctance… But overall, it is now much better, and the communication is more open and honest.”

Another industry representative summed up their attitude towards the new collaboration: “We like to say that collaboration ‘gets more done better quicker.’”

Government participants noted that the relationship among partners had improved: “The interaction between government and industry most certainly has improved… And it’s also true that within the industry, the interaction has improved.”

While the main focus of this observation and others of its type was on the interaction between government and industry, this speaker also singled out the relationship among companies.

A side benefit of improving the communication and coordination among OEMs was that each one changed internal processes to improve the coordination further. An industry representative noted: “PNGV allows a flow or implementation path within their own companies. Without it, it’s very difficult to transfer an idea to their companies. So PNGV serves as both technology and policy in assisting in the transfer of technology.”

This quotation indicates that needs for coordination and technology transfer within the companies helped improve the implementation path within each one.

14 Interview with industry technical staff G, 1998. Note that this statement was made long after the time in question.
15 Interview with industry manager E, 1999. This quotation also appears in Chapter 8.
16 Interview with government manager D, 1999. Part of this quotation also appears in Chapter 8.
17 Interview with industry technical staff C, 1998.
Clearly, cooperation among the industry partners took place at a technical level. But the benefits also surpassed this technical cooperation. One indication of this is the newfound consolidated public presence they have had in recent years. An industry representative interviewed noted such a benefit of the automakers working together: “PNGV brings a credible and collective voice for the industry – they agree on more, and can have a common dialog and some common understanding.”\(^{18}\)

Not only were they communicating and forming common understanding, but they would soon be coordinating their statements and even making joint statements. Another industry representative explained, “When we go to talk to Congress, it’s not Ford or GM or Chrysler. It’s all of us. It’s our data. There’s no more B.S. in footnotes.”\(^{19}\) The footnotes that this individual refers to presumably have to do with qualifications that each OEM previously provided on its own data.

There are many examples of coordinated or joint statements on the part of the Big Three and/or USCAR during the 1990s. The Big Three prepared a joint statement for the 1996 Congressional hearing on the partnership.\(^{20}\) Ford vice president William Powers represented the USCAR partners in an address at Vice President Gore’s 1997 PNGV technical symposium. A third example is provided in a 1998 letter to *National Journal* by the Big Three PNGV directors and George Joy, chairman of the government’s PNGV Technical Task Force.\(^{21}\) Joint statements of this sort not only demonstrate a change in the

\(^{18}\) Interview with industry manager D, 1999.

\(^{19}\) Interview with industry manager B, 1999.


coordination among the Big Three, but they also highlight a benefit of working together – the ability to assess policies together and form joint, coordinated responses.

More evidence of improved willingness to work together may be found in a physical change in USCAR. In 1999 USCAR moved from Dearborn, Michigan – home of Ford headquarters – to nearby Southfield, Michigan. Planned in order to provide more central access to USCAR for all of the Big Three, the movement was done to permit greater cooperation. As one participant noted, “The previous site … bothered some at Chrysler and GM because it sat in the middle of ‘Ford territory.’”22 A more central site for USCAR was seen as both more convenient and more neutral.

In addition, the move was seen as a symbol in itself. Ron Beeber, at the time the director of communications for USCAR, felt the move was a sign that the Big Three were pleased with USCAR: “I don’t think the automakers would have spent the money and signed a five-year lease for this space if they were unhappy.”23

An effect of the rise in the willingness to cooperate among domestic OEMs was an increasing interest on the part of the Big Three to work with others in the industry, including foreign OEMs. Indeed, the Big Three have also teamed up in the late 1990s with other OEMs, suppliers, and stakeholders in other efforts to develop alternatives to the internal combustion engine. For example, General Motors and Toyota joined in one effort to develop advanced automotive fuel cells, and Ford, DaimlerChrysler, Ballard Fuel Cells, oil companies, and the state of California joined in a separate effort.24 These efforts were not part of the domestic PNGV partnership, so some may think of them as

22 Dale Jewett, “USCAR chief’s goal is Big 3 harmony,” Automotive News, April 7, 1997, p. 56.
23 Quoted in Jewett, April 7 1997, p. 56.
working counter to some of the PNGV motivations. However, the fact that the OEMs entered into additional cooperative efforts that included PNGV participants in some cases suggests that they were not dissatisfied by their experiences in the efforts they had been in previously; both in consortia of USCAR and in PNGV.

Within USCAR, one industry representative interviewed speculated that there was an apparent increase in the willingness of the Big Three to work with other OEMs on a case-by-case basis, which could result in very different types of consortia in the future.\textsuperscript{25}

Using the same framework used in Chapter 8, Table 9-1 summarizes interviewee impressions of whether relationships among the Big Three improved since the beginning of PNGV. Again, each shaded “x” characterizes whether a change was noted in each interview. A more lightly shaded “?” indicates that a particular interviewee’s comment had some ambiguity but could be interpreted to indicate the opinion noted. In addition, a darkly shaded capital “X” indicates a particularly strong opinion.

<table>
<thead>
<tr>
<th>Change in Relationship</th>
<th>Industry Interviews</th>
<th>Government Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Worse</td>
<td>Same</td>
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<td></td>
<td>x x x x x x</td>
<td>x x x x x x</td>
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</table>

Table 9-1: Interview Opinions on Industry Relationships

Unlike the topic of the government-industry relationship discussed in the last chapter, not all interviewees identified a shift in the relationships among the Big Three. Nine of the twelve industry interviewees identified a positive change in the relationship, and none suggested a negative change or no change. However, only three of the nine

\textsuperscript{25} Interview with industry technical staff A, 1998.
individuals interviewed from government had an opinion on the shift. From these interviews, all clear statements regarding a change in the relationship agreed that there was a change. Again, this is not as much of a consensus as was true in the last chapter, but it indicates a consistent impression for those that had one.

**Attribution of Success to PNGV**

In addressing changes in the industry relationships, some of the statements in the last section are specific in attributing changes to PNGV or other efforts, while other statements note only the changes. This section draws out differences between PNGV and other policies and organizations that some individuals give credit to for the improvements noted throughout this chapter. At the same time, it provides further evidence for the improvements themselves.

Some observers note the importance of progress prior to PNGV in laying the groundwork for its cooperation. For example, Gruley and Gannon noted:

> Before they could work with government, the automakers had to learn to work with one another. For years, GM, Ford and Chrysler disagreed – and often lobbied separately – on many trade, tax and regulatory matters. In the late 1980s, that began to change. The companies launched a handful of joint research projects, including one to develop batteries for electric cars.

As the authors pointed out, agreement and cooperation among OEMs had started prior to PNGV

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26 From context, this suggests that the automakers have or had lobbied together more at the time, but I could not verify that statement elsewhere.

27 Gruley and Gannon, 1993, p. 1D.
Similarly, an industry participant noted, “We have a significant commitment in these technologies, even without the government. You know, the collaborative work between the automakers pre-dated PNGV.”

Yet another industry representative interviewed noted improvements in the relationships among industry participants – at least some of which pre-dated PNGV: “Over time, the relationships [among the industry participants] are improving – the individuals know each other better. But many knew each other before, too.” From these quotations, we infer at least that to some knowledgeable observers, PNGV cannot claim all the credit for communications and coordination among the Big Three.

In contrast, other quotations help discern some of the benefits more specific to PNGV. Speaking of PNGV with respect to USCAR efforts, one industry representative perceived that – prior to PNGV – USCAR only included certain types of efforts: “USCAR is really working with what’s already going on.” This same individual observed other added benefits of PNGV:

PNGV does force companies to get together in various areas, such as fuel cells and standardized components. USCAR alone did not have the power to shift how companies do things. Also, USCAR wasn’t very publicized. PNGV is constantly quoted by Clinton, and it has some Congressional support. USCAR has no political force. The deals are made through tier I [primary] suppliers.

Another industry participant noted that the PNGV technical teams and vehicle goals helped focus the efforts of the OEMs, and the elevated presence of PNGV over

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28 Interview with industry technical staff H, 1998. Note that this statement was made long after the time in question.
29 Interview with industry technical staff H, 1998. Note that this statement was made long after the time in question. Part of this quotation also appears in Chapter 8.
30 Interview with industry technical staff C, 1998.
31 Interview with industry technical staff C, 1998. Note that this statement was made long after the time in question.
USCAR brought further attention to relevant efforts. This individual noted: “PNGV brought a more focused set of goals.”

At least some among the government participants agreed that PNGV enabled more than USCAR alone. One noted the effect of PNGV on USCAR: “PNGV enabled USCAR to grow. It became far more effective than it would have been otherwise.”

To summarize the opinions expressed by the interviewees from government and industry, all that commented on the relationships within the industry noted the improvements, as shown in Table 9-1. Of those, many agreed that PNGV had a role. Table 9-2 summarizes the opinions of all of the participants interviewed on whether PNGV was the cause of the improvements they perceived in the relationship between government and industry. Again, each shaded “x” characterizes whether a change was noted in each interview. A more lightly shaded “?” indicates that a particular interviewee’s comment had some ambiguity but could be interpreted to indicate the opinion noted. A darkly shaded capital “X” indicates a particularly strong opinion.

### Table 9-2: Interview Opinions on Industry Relationships and Attribution to PNGV

<table>
<thead>
<tr>
<th>Change in Relationship</th>
<th>Industry Interviews</th>
<th>Government Interviews</th>
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<td>Better</td>
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<td>X x</td>
</tr>
<tr>
<td>Same</td>
<td>x x x x x x</td>
<td>? x x x</td>
</tr>
<tr>
<td>Worse</td>
<td>x x x x x</td>
<td>x x</td>
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</table>

<table>
<thead>
<tr>
<th>Attribute to...</th>
<th>Industry Interviews</th>
<th>Government Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNGV</td>
<td>x x x x x</td>
<td>X x x x</td>
</tr>
<tr>
<td>Other</td>
<td>x X x x</td>
<td>x x</td>
</tr>
</tbody>
</table>

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32 Interview with industry technical staff H, 1998. This quotation also appears in Chapter 8.
33 Interview with government manager C, 1999. Note that this statement was made long after the time in question. This quotation also appears in Chapter 8.
Specifically, of those interviewed that noted an improvement in the relationship (12 individuals), a slight majority (seven) attributed it to PNGV. Of those, slightly less than half (three of seven) attributed the improvement to PNGV alone. However, some also point to the role of USCAR, preexisting consortia, and other preexisting policies that helped enable these improvements. None of the interviewees stated that PNGV had no role. Industry participants had more to say than government participants about improvements in industry relationships.

**Changes in Technical Relationships within the Industry**

One specific change in industry has been in the relationships among technical staff among the Big Three. Prior to the consortia of the late 1980s and USCAR, interaction among the staffs of competing companies was difficult – if not discouraged – other than interaction through professional associations. Indeed, many types of cooperation were not legal, prior to the legislation that broke down old antitrust restrictions and paved the way for the creation of the consortia. With the new abilities to cooperate, companies were able to identify targeted, precompetitive areas, in which cooperation could be mutually beneficial. PNGV provided new goals and partners to the table, and with them, more and more opportunities for mutual benefit.

Bill Powers, Ford Vice President for R&D, also saw PNGV as a “catalyst” for collaborations between the government and the auto industry as well as among the auto companies themselves: “Antitrust laws … traditionally discouraged the auto industry from cooperating. But having DOE and the government in the room has helped the Big
Three collaborate, and the same goes for the government agencies’ involved in the joint venture.”

Indicative of the attitudes among the industry participants, one noted that having technical representatives at the same table was more than symbolic: “When GM has something to say about some technology, you’d better listen.” Thus, at the technical level, the industry representatives were motivated to meet and listen to one another.

Another industry participant further noted the congeniality among technical peers:

In the tech teams, there’s no fighting. They just concentrate on the technology. The tech guys love it, they love to get together. But they always have to be cautioned by what their companies are doing… I think that’s the biggest benefit [of the partnership]. The cooperation means they communicate, they have new technical resources, and they reach solutions quicker.

Even if the technical participants could not forget their roles within their respective companies, they worked together towards their common ends.

Ultimately, some saw the technical interactions across company lines – both the advantages and the difficulties – as typical of what distinct groups experience within large teams: “Really, the PNGV tech teams are not different from any other cross-functional, cross-organizational teams.” While this quotation is in the context of the problems of cross-team dynamics, the fact that one can even think of these teams spanning competing companies as at all typical of cross-organizational teams is remarkable in itself.

36 Interview with industry technical staff A, 1998.
37 In the course of my support for the PNGV Secretariat at the Department of Commerce, I interacted with two PNGV tech teams directly.
38 Interview with industry technical staff H, 1998. Note that this statement was made long after the time in question. This quotation also appears in Chapter 8.
One government participant noted a significant shift in thinking on the part of Chrysler Vice President Francois Castaing, which may help summarize the value that was placed on improved interactions: “Castaing really made it happen. He said he used to think that if somebody wasn’t at their desk, that they were goofing off. Now he says if they are at their desk, they’re not doing what they should be doing.”39 Thus, for at least some efforts, a measure of productivity for technical staff would no longer be time spent at ones desk, but rather time spent interacting with others.

PNGV helped to introduce a dramatic new mode of interaction among industry technical staffs, but it is difficult to find evidence to credit such changes solely to PNGV. It seems that PNGV may have increased and multiplied the level of interaction that USCAR and the preexisting consortia were already working to improve.

Obstacles and Continuing Challenges

Despite the clear improvements in the relationships among OEMs, certain issues or aspects of the relationship continued to require care through PNGV’s existence. Identifying these issues helps provide context for the outcomes of the larger partnership, but it can also help participants of other industry efforts to be mindful of potentially difficult areas. Among these issues are cultural differences among the companies, cooperation among competitors, and effects of the DaimlerChrysler merger.

Cultural Differences among Companies

Despite being in the same industry and geographic region, the Big Three developed distinct corporate cultures over time. During the course of the partnership

some differences were apparent when employees would meet together for meetings, as the companies had different dress codes and cultures. Other differences were more structural, as GM, Ford, and Chrysler have had differing approaches to integrating their supply chains.

Industry participants highlighted a few of those cultural differences that were relevant to cooperation. One observed, “There have been changes over time – the relationship has improved; it’s more focused. But there are still cultural differences. The companies have slightly different philosophies; slightly different desires. GM and Ford have more of their own systems [than DaimlerChrysler does].”

Another stated, “The culture of Ford and GM is very similar. They are both research organizations, while Chrysler isn’t, per se. Chrysler people tend to be tied into the current product.” Most participants and observers accept these differences as a fact of life.

Such differences can affect the nature of the coordination directly, if the differences have to do with what each company does or how it does it. For example, if one of the companies has less in-house research, it follows that that distinction could affect its role in a research partnership. Cultural differences may also have other effects, if the differences in business procedures or assumptions lead to misunderstandings.

### Balancing Competition and Cooperation

In working toward common ends, the automakers coined a term to describe the balance between cooperation and competition: “PNGV represents one giant stride by

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40 Interview with industry technical staff D, 1998.
auto makers that many within the industry call ‘coopetition,’ a pursuit of common goals without stifling proprietary achievement.“**42**

More specifically, an industry representative described the process in the following way: “The companies are each alone in a competitive atmosphere. The more you know about your competition drives you to do more. It’s what [USCAR’s executive director] Elizabeth Breukner calls ‘coopetition’ – by helping your competitor, you’re helping yourself.”**43** Whether seen as a paradox or a continuing tension, balancing cooperation and competition posed an enduring challenge for the industry participants.

The tensions between cooperation and competition were recognized from the start. Early on, corporate executives met to discuss the appropriate subjects of cooperation, in particular, precompetitive technologies, as Buntin describes:

PNGV promised to be a challenging step toward much closer cooperation. In order to work together on joint ‘precompetitive’ projects, engineers from each of the automakers would have to overcome the ingrained belief that each automaker’s research was proprietary and hence a secret. Disputes were inevitable. In order to address them, the vice presidents and PNGV directors of each company would meet on a regular basis at USCAR headquarters to discuss how inter-company cooperation was proceeding and to sort out any questions about which technologies were ‘precompetitive’ or ‘competitive.’**44**

By many accounts, cooperation among competitors was especially confusing among newcomers to the partnership: “You still see reluctance with new people. You waste 15 minutes in meetings just getting comfortable with each other.”**45**

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**41** Interview with industry technical staff F, 1998.
**42** Dean, 1999, p. W-1.
**43** Interview with industry technical staff C, 1998. Elizabeth Breukner was the USCAR executive director at the time of this quotation. Participants referred to the term “coopetition” repeatedly – origin is unknown.
**44** Buntin, 1997, p. 16.
**45** Interview with industry technical staff G, 1998. This quotation also appears in Chapter 8.
This initial discomfort eased into good-natured rivalry, at best. As Crain noted, “Yes, the Big 3 are talking about common problems for the first time… Yes, let’s be pleased that on many issues, these three companies can work together. That is a great step forward… But don’t think that the intense rivalry between these companies has dwindled.”

Indeed, others also noted persistent signs of competition among the collaborators. General Motors’ PNGV director Ron York noted, “It’s much harder to put together a consortia [sic] between competitors than it would be in a vertical consortia [sic] between, say, a single company and a supplier base. We are very mindful of the fact that while we are cooperating we are also competing.”

Similarly, on the NRC suggestion that the program be directed by a single technical leader from industry, one analyst observed: “But the companies, each of which has its own PNGV director, say putting a single leader over the Big Three is like placing the U.S., Russia, and China under one president.”

An industry participant pondered the very term “partnership”: “It’s a funny kind of ‘partnership.’ Partners should wish each other well. But we can’t.” This same individual noted how the partners have to remain alert: “Companies must keep their eyes open and use what they find, or someone else will.”

Some observers highlight more specific problems that continued to be fueled by competitive fears. Trevor Jones, the chairman of the National Research Council’s review

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47 U.S. House of Representatives, 1994, p. 124. It is unclear from the context whether York is speaking of interactions in PNGV or just in USCAR consortia.
49 Interview with industry manager A, 1999.
panel of the PNGV program, noted that competitive interests undermined some of the benefit the partners might otherwise achieve: “The effort is not really a true partnership among the Big 3 members... My observation is that the (Big 3) partners are overly sensitive – or perhaps too optimistic – over the real competitive advantages provided by their individual technologies, which they elect to classify as proprietary.”51

Similarly, some journalists noted enduring difficulties among competitors. Visnic noted:

Some believe Chrysler has selfishly and rashly used primarily PNGV-oriented research to further the company’s own high-tech profile. And critics also say Chrysler’s scheme somewhat disingenuously promotes PNGV research as essentially proprietary, downplaying the heavily collaborative nature of much of what Chrysler has learned... As you can see, there is an undercurrent of competitive hissiness involved.52

Visnic continued with an example of fuel cell programs each of the Big Three was actively pursuing independently, saying: “Although PNGV-related fuel-cell development is primarily collaborative, each of the Big Three is pursuing fuel-cell research as a competitive advantage. That’s where the whole thing gets, um, interesting.”53

One reason that opinions vary on the success of cooperation among competitors is that the perception depends on the setting. For example, as previously mentioned, technical interactions across company lines demonstrated the strong bonds among technical peers: “You can’t forget that you’re working with your arch-competitors. But when you get good engineers in a room, they just focus on solving the problem. Each

50 Interview with industry manager A, 1999.
company has its own biases of knowledge, but when you get outside the company in a situation of equal footing, the result is very healthy.”54

In contrast, as one industry participant noted, not all gatherings were as cooperative: “Unlike auto shows, conferences may stress collaboration better.”55 Conferences highlighted cooperation among technical peers, while auto shows highlighted the accomplishments of the individual companies.

However, the level of technical cooperation may have depended on the particular technical area:

The working relationship among automakers [in PNGV] depends on which technical area you’re talking about. If they’re working on their own hybrid program, they’re more reluctant to share information. Interactions on those problems are more complicated, and they can even slow their progress. But team members are finding ways to cooperate. If they can’t work on [some technologies], they’ll work to standardize connectors. They really want to work together.56

One interesting side effect of cooperation across companies has to do with the cooperation within companies. Technical staff working with competitors do not always work as closely with the technical staff at their own companies: “In the industry, there is some disconnect between the PNGV effort and the rank-and-file among the companies. The proprietary efforts at each company work under a different agenda.”57

Thus, the automakers had to learn—repeatedly, at many levels, and in many ways—how to cooperate with their competitors. Ron York, at the time PNGV director at General Motors, credited PNGV with enabling the best of the cooperation: “[Because of

54 Interview with industry manager B, 1999.
55 Interview with industry technical staff C, 1998.
56 Interview with industry technical staff C, 1998.
57 Interview with government manager D, 1999.
PNGV], we have learned to use collaborative work and competitive work in combination to get the job done.”

In 1997, Chris Sloan, who would later succeed York as GM’s PNGV director, noted another way to think of this balance: “There’s a natural tension there. It’s like a town with two high schools – you try to root for both.”

The DaimlerChrysler Merger

Another issue that posed a threat to the partnership was the 1999 merger of Chrysler Motors with Daimler-Benz of Germany. Not only did this add a new dynamic to the existing relationships of a mature partnership, but the merger of Chrysler with (or under, as some suspected) a foreign OEM brought into question the expectations and value of domestic cooperation. The event also re-sparked the debate on international competitiveness, what it means to be an American company, and other related issues. Some felt that Chrysler could no longer be considered a domestic automaker, while others felt that, in an era when the large companies were becoming increasingly multi-national, it made little sense to favor some at the exclusion of others. Some suggested that having in-country R&D facilities was at least as important a factor, and that was something that many OEMs, domestic and “foreign,” could claim.

At the time of the merger, Automotive News reporter Harry Stoffer quoted a few industry executives and managers as being unsure or skeptical regarding the outlook for post-merger cooperation.

58 Quoted in Zorpette, 1999, p. 47. (The tone of this article is otherwise somewhat skeptical regarding PNGV.)
Janet Mullins, Ford Motor Co. vice president for Washington affairs, predicted ‘rough waters’ ahead for joint research involving the former Big 3 and the federal government if DaimlerChrysler’s German managers restrict access to company technical information… Her objections are the latest sign that the historic, widely hailed ‘merger of equals’ hasn’t been as smooth as its architects hoped. On the inside, there are reports of culture clash. On the outside, there are complaints like Mullins.⁶⁰

In the article, Mullins continued, saying:

> We know that Daimler sucks all the information out of Chrysler. It’s just not happening in reverse… What we basically said is that ‘you guys can stay in as long as we have access to all the research in your company, not just Chrysler research, but Daimler research… I’m not sure that that information flow is what all of our various PNGV folks would like.’⁶¹

Stoffer also quoted General Motors’ PNGV director Ron York: “Certainly [the post-merger flow of information among partnership members] is a concern, something we are all watching.”⁶² Continuing, York indicated that he hadn’t seen evidence of a problem so far, and in fact offered some hope for more effective cooperation with the addition of Daimler research: “We all agree that if DaimlerChrysler is to participate as a total corporation, that would bring considerable technical expertise from Daimler into play that they are quite good at.”⁶³

Stoffer summarized the tone of uncertainty: “Difficulties in the DaimlerChrysler marriage, either real or perceived, are putting a strain on the extended family of automakers.”⁶⁴

While other assessments of the time raised similar doubts for the continuation of the partnership as a result of the merger, interviews at the time were uncertain, but hopeful. For example, on the outlook for the partnership in light of the merger, an

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⁶² Quoted in Stoffer, 1999, p. 36.
industry representative mused: “On the DaimlerChrysler merger, we don’t know. There’s still a lot of uncertainty. They’re having very high level discussions right now. Until we get other directions, though, we’ll continue working with [DaimlerChrysler] staff.”

As the Partnership continued after the merger without a major shift in industry participation, one can surmise that the partners were still seeing mutual benefit from working together, regardless of the merger.

**Conclusions**

This chapter provides credible evidence that cooperation had beneficial effects upon relationships between companies and in the working environment within the domestic auto industry. However, unlike the government-industry analysis of the preceding chapter, the analysis in this chapter is less conclusive on the specific contribution of PNGV toward these effects, relative to changes that could have occurred with USCAR or its consortia alone, or simply with the removal of restrictive legal prohibitions.

Whatever the cause, improvements in the relationships among the Big Three enhanced the ability of technical staff to coordinate and collaborate, which may have enabled more efficient diffusion of ideas and processes among the cooperating organizations. By making the effort to develop new technology more effectively and efficiently, the Partnership could help speed not only the development of technological improvements, but also their introduction into the marketplace.

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63 Quoted in Stoffer, 1999, p. 36.
Interview with industry technical staff D, 1998.
CHAPTER 10: COMPONENTS OF RELATIONSHIPS AMONG PARTICIPANTS

The preceding chapters discussed how the primary relationships between the industry and government developed with the introduction of PNGV. This chapter explores some of the specific characteristics and dynamics of the relationships between government and industry. These factors help to further demonstrate certain improvements in relationships among participants, and they also help to understand how improvements came to be, what factors made them work, and how they may continue even after the end of the Partnership.

Dissecting a Relationship

A relationship between organizations can be thought of in terms of the various ways and levels that characterize how these organizations interact. Separately, each organization has motivations, constraints, and aspects of internal culture that affect its goals and decisions. When organizations interact – whether resulting from a common need or from a more one-sided requirement – their distinct institutional traits play a large role in the nature of the relationship and its potential for success.

In this section, the term “interaction” refers to any one component of the larger set of communications, meetings, and transactions within the relationship. An interaction could be a one-time connection (e.g., a one-time seminar), a regular connection (e.g., a weekly phone call or monthly technical meeting), or even a mode of connecting between partners in a particular effort (e.g., a particular technical team’s coordination). In all cases, the interaction is one link or type of link among many.
One might characterize an interaction as shown in Figure 10-1. Going into a given interaction, the prior experience of the participants and their motivation for participating (A) affect what they are willing to do, and how open minded they are to the interaction. In turn, this motivation level will affect the ways in which they interact (B), including the types and depth of their interactions, and the communication that develops. The participants may find success in the substantive outcomes of the interaction (C). Thus, one outcome of an interaction can be the success of the interaction itself – the extent to which the interaction achieved its immediate objective.

**Figure 10-1: Interactions Between Institutions**

For example, as this chapter shows, participants of various PNGV technical teams and USCAR consortia initially lacked trust in dealing with other companies, with new people, and across sectors. Each company and sector not only had its own interests to protect, but each had its own culture, which was discernible, for example, through differences in dress code.

While interactions are generally assessed in terms of their apparent technical success (or lack of success), technical success is not necessarily the sole outcome of an interaction. Figure 10-2 shows Figure 10-1 in the context of a larger, iterated role of an
interaction. In addition to the technical outcomes, there are other possible outcomes of an interaction, as shown at (C). First, the interaction may require or suggest a different institutional structure to better handle the interaction. A secondary set of outcomes includes other experiences of the participants in the interaction.\footnote{These factors are a type of outcome having to do with the effect the process has on the relationship, whether through new perceptions of other partners or the interaction, new recognition of some benefit of that or future interactions, or improved understanding of the motivations and methods of other partners. In turn, such changes in perception and mutual understanding may lead to changes in attitude (D), towards either other partners (e.g., trust) or the partnership itself (e.g., increased support or optimism). Much in the same way that the motivation level affects a given interaction, perceptions and attitudes resulting from one interaction (D) may result in new types of motivation (A) for further interactions.}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure10-2.png}
\caption{Effects of Interactions on Institutional Relationships}
\end{figure}

\footnote{A later section of this chapter discusses the extent to which some consider the change in the relationship to have been a primary goal. For now, in this more general context, this discussion refers to relationship-based outcomes as secondary to the technical outcomes.}
Clearly, interaction and communication are necessary to achieve a joint objective. In the process, any increased interaction and communication may lead to improved understanding between participants. In the course of working together, participants learn the processes and working styles of other groups. Each group learns more and more of the terminology and processes of the other groups, which itself increases mutual understanding. As an outcome of the interaction, the participants may simply have their preconceived notions confirmed, or they may develop new attitudes towards one another. With greater communication and increased interaction, the participants may even come to find new levels of trust. As the figure indicates, this process is iterative, as more and more iterations (and their outcomes) may affect the motivations for participating and the effectiveness in doing so.

However, this process is not as well defined or linear as the figure indicates, as the seemingly interim steps can themselves affect the motivation, and exogenous factors can have dominant effects on this chain of interactions. Furthermore, while greater interaction can yield increasing changes in subsequent iterations, it is unlikely that these benefits would continue to increase indefinitely. At some point, the benefits will be hindered by other factors and constraints.

In the case of the PNGV some technical team members who came to meetings initially distrustful of others soon found that they could work together effectively on technical matters, not only getting the technical job done but also learning how to communicate and to trust the other participants.
The following sections follow a path through the cycle of Figure 10-2, exploring first the modes of interaction, then continuing on to outcomes of the interactions and the subsequent effects on the relationships.

**Modes of Interaction**

There are various forms of interaction that can develop between partners, and there are various ways to characterize or monitor these interactions. Examples of characteristics include:

- the frequency of interaction
- the activities that comprise their interactions and communications (e.g., memos, calls, meetings, social interactions outside of meetings)
- the tone of their interaction (e.g., friendly, technical, official, adversarial)
- the organizational levels at which they interact (e.g., technical staff, management).

The relative strength of the interaction is a product of these factors, and one might approximate the change in the nature of the interaction by noting changes in these factors before, during, and after an interaction (or the partnership as a whole). Another indication is the extent to which partners coordinate their efforts, aligning their goals and/or leveraging on the efforts of one another.

This discussion fits into Figure 10-2, reprinted here as 10-3, as the shaded component (B). The following pages discuss how communication has developed and changed among partners, and, with it, coordination has improved. Within and between partners, certain structural changes have resulted from these interactions, which have, in turn, facilitated further improvements.
Over the years, companies in the auto industry were responding to increasing regulation. As companies struggled to comply, regulators appeared to have little sympathy for their difficulties. As an industry participant noted in an interview: “Communication [between government and industry] didn’t exist before the partnership.”

While this statement can’t be taken literally, it indicates a relative lack of cooperative dialogue.

As the early Clinton administration was initiating talk of a new openness and cooperation with the automotive industry, Representative John Dingell (D – Michigan) observed: “Every administration makes noises of this sort… Some intend to have more or less meaningful dialogue, and in that respect, [Clinton's effort] is not unusual. But in the quality and the quantity, it is… [Automakers also sought a dialogue before], but in the old days, they meant, ‘Leave us alone.’”

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2 Interview with industry manager C, 1999. Note that this statement was made long after the time in question.
3 Quoted in Gruley and Gannon, 1993, Page 1D.
As the partnership was taking form, industry saw the benefit in getting the government to understand the problems it faces, technical and otherwise. After their initial hesitance to partner with the government, Buntin noted: “In the end, the Big Three decided to participate. What clinched the deal for the Big Three was the opportunity to gain an unprecedented degree of access to the administration’s policymaking process.”

Buntin continued, quoting Ford Chief Executive Officer Harold “Red” Poling: “This was an opportunity to work closely with the government so there would be no question when the results [of the research] were finally determined… They would understand the issues that we addressed, the problems we were faced with, and how realistic the objective was.” Thus, according to Mr. Poling, industry saw the ability to communicate its problems and work with the government policymakers as a potential benefit of technical cooperation.

With respect to this communication, many sources note that things seemed to get off to a good start. As one industry representative noted: “Right from the start, we had a good dialogue.”

Other industry participants and representatives also note this result. AAMA President and Chief Executive Officer Andrew H. Card, Jr. cited the Partnership for a New Generation of Vehicles as an example of this new kind of teamwork: “After years of fighting each other, the auto industry and government are learning to work together toward common goals. It’s not easy, but we are making progress in a few critical areas…

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4 Buntin, 1997, p. 9. Note that this statement was made long after the time in question.
5 Quoted in Buntin, 1997, p. 9. Note that this statement was made long after the time in question.
6 Interview with industry manager C, 1999. Note that this statement was made long after the time in question.
We are now engaging government at all levels with the hope that a better understanding, on each side, will produce better public policy.”

A quotation from a government participant noted a more specific change in how the coordination progressed: “At first we were meeting every couple of weeks – three meetings in Detroit to each one in DC. [One of the OEM directors] would never be able to schedule the meetings… But the working relationship got better with time and with changing mixes of personalities.” Despite some initial difficulty getting full participation from among the PNGV directors, the working relationship improved with time and as the people involved changed.

As the partnership continued to develop, participants noted the effects of increased communication. An industry participant interviewed observed: “[Prior to PNGV,] any conversation was a negotiation – a win-lose game. Both between companies and between industry and the government. [Now government and industry participants] openly dialogue on subjects.”

Another industry participant interviewed noted an improvement in both the interaction within the industry and also between the industry and government:

Among the industry, the interaction has become much better – a freer flow. Between ’93 and ’94 the rapport improved. Still there are positioning problems and continuing reluctance… But overall, it is now much better, and the communication is more open and honest. It’s my impression that [the relationship between OEMs and the government] is better as well. There’s a more regular

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8 Interview with government manager A, Washington, D.C., September 20, 1999 (name withheld on request). Note that this statement was made long after the time in question.
9 Interview with industry manager D, 1999. Note that this statement was made long after the time in question. Part of this quotation also appears in Chapters 8 and 9.
dialogue. And there’s sometimes confrontation, but there’s open communication. It used to be that both sides would keep each other in the dark.10

Thus, for both types of relationship, there was still confrontation, but the communication established helped participants work things through more constructively.

In 1994, Ron York, General Motors director for PNGV, expressed his support for the difference the partnership was making: “We really endorse this atmosphere of cooperation and trust which provides the foundation for progress.”11 A few years later, York noted: “[Government and industry have] really come a long way in fashioning organizational and personal relationships that are helping us make decisions and get things done.”12 This quotation highlights how the communications were progressing – both through the organizational shifts coming with the partnerships, and also through the less formal relationships that result. Here and elsewhere, York seemed to put a high value on the improvements in the relationship he saw developing.

On the industry side, one interviewee explained: “As a result of PNGV, companies are talking to each other more.”13

Another industry participant explained the specifics of the communication that developed: “Every Thursday, from eight to three-ish, we would talk to get the three companies working together.”14 This participant noted that keeping participants aligned was a lot of work and that they found this level of communication was necessary. Moreover, given that these or similar weekly meetings continued for years, the participants must have perceived some value.

10 Interview with industry technical staff G, 1998. Part of this quotation also appears in Chapter 9.
11 U.S. House of Representatives, 1994, p. 72, 73.
12 Quoted in Hileman, 1997, p. 31.
13 Interview with industry technical staff C, 1998. This quotation also appears in Chapter 9.
In an interview, another industry participant of the partnership provided an illustration of the significance of personal relationships formed through the partnership: “[The improved communication is] true in frequency, both formal and informal – I mean, we have the home phone numbers of people in the agencies and in the White House. We’re always having sidebar conversations now.”

Having access to participants outside of the workplace implies that communications had become both more frequent and more informal.

Participants noted several benefits of the improved communications. Government could better see the technical and other challenges industry faces. Industry gained an avenue to explain and show the effects of policies while they are in formation. And, in return, industry would better understand more of what drives government policy. As one industry manager noted: “This job has two key elements: I go to [Washington, DC] to explain what industry is doing and why it’s important, and then I come home and explain the politics.”

In the later years of the partnership, at the time of all of the direct interviews used in this dissertation, participants still identified a strong level of communication, if some indicate that it had diminished in frequency. An industry participant interviewed recalled: “Early on, we were meeting quarterly, discussing issues and educating each other. Now we’re meeting less frequently, but we must keep doing it.”

However, in interviews, a few participants noted that the need for frequent communications in some

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14 Interview with industry manager A, 1999. These Thursday calls were also noted in Interview with industry manager B, 1999.

15 Interview with industry manager C, 1999.

16 Interview with industry manager C, 1999.
aspects of the partnership had decreased as the interaction was shifting its focus through the different phases of the partnership itself.\textsuperscript{18}

Finally, one industry participant expressed the success of increased communication in achieving that goal: “PNGV allows an open dialogue, where the participants can be objective and honest… It’s all about how to make constructive public policy.”\textsuperscript{19} Ultimately, the benefit of communication was the same as the larger goal – in this case, a productive relationship.

\textbf{Coordination}

Not only did the level and type of communication improve over time, but many sources indicate that the partners also increasingly coordinated their activities or had influence on certain aspects of the activities of other partners. For example, a 1998 report from the National Science and Technology Council (itself a coordinating body of representatives of federal R&D agencies) said of PNGV: “Its beneficial impacts include increased coordination and communication among government and industry.”\textsuperscript{20}

To discuss coordination between organizations, it would help to explain what that might mean. One might say two entities are somewhat coordinated if they simply work closely together, where each is aware of the actions of the others. Full coordination, however, requires that actions of each entity have interdependencies with actions of the others. Logically, coordination is easiest if entities can communicate frequently and meaningfully, which can be facilitated if they are located near one another. Coordination

\textsuperscript{17} Interview with industry manager C, 1999. Note that this statement was made long after the time in question.
\textsuperscript{18} Interview with industry manager D, 1999 and others.
\textsuperscript{19} Interview with industry manager D, 1999.
may be further assisted if the entities in question have (a) common motivations or goals, (b) similar processes or structures, or (c) similar institutional cultures. One might think of a spectrum of coordination, from disjointed at one end to fully coordinated at the other. Between the extremes, one might see shades of consistency and alignment.

Perhaps at the more disjoint extreme is the “win-lose game” that some had labeled the government-industry relationship previously.\(^2\) Conversely, a highly coordinated interaction may enjoy levels of synthesis, where the results of the coordinated efforts are greater than those possible through the efforts of the individual participants. Figure 10-4 provides a representation of how the uncoordinated efforts of government and industry (left) could become better aligned through improved coordination (right). This could happen as coordinated efforts help shift the direction of some efforts to align them better towards mutual goals. In the representation on the right, some of the efforts of government and industry are moving in a similar direction, assisted in part by the improved focus of each taken individually towards that direction.


\(^2\) Interview with industry manager D, 1999. Note that this statement was made long after the time in question. This quotation is also noted in Chapter 9 and earlier in this chapter.
As the last chapter discussed, some of the increased alignment and coordination on the industry side was due to USCAR. However, many stakeholders identify the motivations of working with the government, which would suggest that at least some of the change was due to the broader PNGV effort. Furthermore, the existence of the associated industry consortia of USCAR would have had little effect on federal agencies at that time, without the additional layers of PNGV.

For some efforts within PNGV, this coordination took the form of the participants aligning their goals. Several participants, especially from industry, noted in interviews that government and industry gained certain types of alignment in some of their technical goals.

For example, in an interview, one industry participant observed: “Working together provides the capability of knowing what to focus on, and how.”\textsuperscript{22} As this statement suggests, developing common goals permitted a focus that factored in the

\textsuperscript{22} Interview with industry manager D, 1999.

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abilities and individual goals of other partners.\textsuperscript{23} This same individual also noted the increased ability to identify promising (and presumably more readily applicable) technologies: “[The government and industry] are much better aligned on what’s important or not important… [PNGV is] helpful for government, [as the focus it provides] brings a sense of responsibility to the process.”\textsuperscript{24} This speaker implied that the focus on practical implementation provides government with better justification for its efforts.

Another industry participant agreed that there was increased alignment, going as far as to quantify it: “The most significant accomplishment is financial. [Government and industry] are now striving for mutual goals, especially with DOE. We’re now 80 to 90 percent aligned.”\textsuperscript{25} In this statement, the individual observed the alignment of government and industry goals and went as far as to suggest that the resulting efficiency was the most significant accomplishment of the partnership.

Interestingly, another participant from industry used a similar numeric estimate for the level of alignment among the government and industry: “Originally, half to a third of [DOE’s automotive research] budget was relevant to what we were focusing on. The directors are now saying 90 percent is right on target.”\textsuperscript{26} While the “90 percent” figure was not a measured numeric quantity, it is still useful as a subjective indicator of how well aligned the partners were felt to be. That both individuals used a similar metric

\textsuperscript{23} While they acknowledged improvement, some industry participants point to continuing problems getting to focus on the right things, or do them quickly enough.\textsuperscript{24} Interview with industry manager D, 1999.\textsuperscript{25} Interview with industry technical staff D, 1998.
may suggest a similar impression or a common, trusted source for that particular metric, or both.

In the last quotation, the observation of increased alignment is interesting, because it is specific to how government research programs shifted their focus to align with industry. Not only did the industry have to shift its efforts in order to develop advanced prototype vehicles to meet the goals of the federal PNGV program, but the government agencies – such as DOE – also had to shift to provide relevant R&D for the vehicles. Other participants from industry also noted the shift in direction of ongoing government efforts. For example, one said: “We have good alignment with DOE. It’s much better now. DOE has aligned its program to the goals of PNGV. There have been projects the labs had been doing that they called PNGV, but [one of the consortia] did not support. And also the technical team has done reviews, resulting in the suggestion to kill some programs.”27 In these statements, this individual noted the improvement in the alignment in general, and specifically the DOE alignment with PNGV goals. The speaker attributed this both to the conscious efforts of the Department and to the technical-team reviews.

Part of the alignment comes with greater understanding among the technical participants from the government side (often in the national laboratories) of the challenges faced in integrating technologies into working prototypes. Several industry representatives noted increased appreciation among lab staff for more practical considerations. One said: “The successes have been subtle. There is greater alignment

26 Interview with industry technical staff B, near Detroit, Mich., November 17, 1998 (name withheld on request). Note that this statement was made long after the time in question.
27 Interview with industry technical staff F, 1998.
of the objectives of the national labs… Plus scientists at national labs are talking about affordability, and not just off doing theoretical engineering.”

Another industry participant agreed, noting that the coordination helped the government research focus on more practical technologies: “Before, the government was shooting money all over. Batteries are an example. DOE funded many types of battery research for a long time. Sodium batteries just aren’t very practical. Industry involvement helps direct government researchers away from the impractical technologies.” Of course, relative to the R&D the industry partners were most familiar with, it is not surprising that government R&D may have seemed less focused on particular applications and less practical, given the tendency of the government to focus more on longer-term, higher-risk research, except in certain areas of particular public benefit.

Yet another participant noted the same benefit of focusing government but commented that getting government to focus can be difficult: “Much of the interaction with the government involves steering them to work on the right problem.”

While some were impressed at the increased alignment of the objectives at the labs, some were also aware of the difficulties associated with steering the government efforts. In addition to the work involved, this individual also identified a risk associated with steering the government at all: “If [the government shifts direction towards a technology that industry suggests], the OEMs are somewhat obligated to use it.”

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28 Interview with industry manager B, 1999.
29 Interview with industry technical staff A, 1998. Note that this statement was made long after the time in question.
30 Interview with industry manager A, 1999.
31 Interview with industry manager A, 1999.
industry was motivated to try to steer the government toward what it felt to be practical solutions, this could in turn affect the industry itself. As such government shifts could result in increased pressures on industry to use the results, at least some in the industry had learned to be careful what they wished for.

In addition to improved alignment, some efforts benefited from leveraging on other ongoing efforts. This was particularly true on the industry side, which benefited greatly by leveraging on the expertise and experience of the national laboratories. One of the changes affecting industries more and more has been the decreasing capability to be self-reliant. In a special type of coordination, leveraging allows one entity to use the resources or processes of another entity to make its own more effective.

Larry J. Howell, executive director of science for General Motors, outlined the benefits of leveraging off of other organizations:

[Leveraging] just makes sense… When you’re not yet in a marketing stage of development, it’s hard to cover all of the technologies available. Even large corporations can no longer lay claim to maintaining the universe of specific technologies. We look for centers of expertise with whom we can team up… In the PNGV, for example, we found lots of opportunities to leverage with Ford, Chrysler, and the U.S. Government.32

Of the Big Three, General Motors in particular declined in maintaining its in-house supply chain, moving more and more towards going to external suppliers for components and subsystems. The increased leveraging ability Howell identified would seem to naturally help General Motors as it moved to be less self-contained. While his statement didn’t necessarily attribute this ability to PNGV, Howell indicated that PNGV had provided new leveraging opportunities.

An industry participant interviewed noted some potential for this sort of leveraging, and suggested that government research on its own might not accomplish much. “PNGV helps leverage the R&D capability of the country. While government labs are working to contribute to some long-term technologies and science, they don’t necessarily want their research to do anything”33 This view of the role and process of government research may be a subjective impression of government R&D relative to industry R&D, which tends to be focused on nearer-term application. However, the point is still valid that there are benefits to combining the long-term resources and focus of the government with the focus and know-how industry has to implement technologies into fielded designs. Further, it appears that these benefits were recognized by the PNGV participants.

In an interview, another industry participant echoed this idea and mentioned another benefit of the partnership to government efforts: “The process leverages off the national labs, building on the knowledge base of experts and their capabilities for doing research. It may also help align government defense and transportation research.”34 In addition to possibilities for industry to leverage on the ongoing efforts at the national labs, the partnership may have also permitted greater alignment of the ongoing research across agencies. Another industry interviewee noted: “We have had some success cross-sharing at the labs. We’re seeing more coordination among the national labs.”35

33 Interview with industry manager D, 1999.
34 Interview with industry manager D, 1999.
A government participant interviewed made a similar observation: “One thing the government started doing was to coordinate its efforts and to weed out duplication. There had been no inventory up to that time.”

Finally, this coordination also applies to relationships between OEMs and suppliers. For example, one government participant stated that the increased coordination among government and industry participants extends beyond the automakers to more direct coordination with the suppliers: “As is, there is pretty good coordination. On a day-to-day basis, the partnership is increasingly working with the supplier community.”

An industry representative highlighted the efficiencies gained in working with other OEMs – and their suppliers: “How can the tech team get to the supplier base? It’s not through conferences… You can get to the suppliers through the companies, leveraging on the relationships each has with its suppliers. There’s a synergy, with the exposure of each company’s supplier with the other companies’ suppliers.”

Among all of these improvements and benefits the participants identified, some in industry also identified difficulties and disappointments in trying to shift the federal efforts to match what they considered to be more productive directions. For example, regarding research at Department of Energy labs, one industry participant cautioned: “Between the budgeting and contract administration and inertia, the opportunity to

36 Interview with government policy official E, 1999.
37 Interview with government manager B, Washington, D.C., September 28, 1999 (name withheld on request).
38 Interview with industry technical staff D, 1998.
restructure or refocus their efforts is relatively small. In another instance, a
government participant at another agency was concerned that the industry expected to be
able to shift other ongoing federal research to be more practical.

This author’s impression is that neither industry nor government participants
understood fully the constraints of other partners and, as a consequence, were unable to
set their expectations appropriately. Some among the industry groups were frustrated by
their inability to focus more of the federal research, and some among the government
agencies seemed to resent the attempt.

Part of the frustration industry experienced may have stemmed from the
variability among agencies in the extent to which they can redirect their efforts from their
respective missions, as well as the extent to which the particular missions were aligned
with the goals of PNGV. For example, it is relatively easy for DOE to justify automotive
related research, while the National Aeronautics and Space Administration (NASA) and
the Department of Defense (DOD) have more restrictive missions.

This concern or resentment does not appear to have persisted, however, as few of
those from government this author spoke with several years into the Partnership
expressed any sort of resentment for what industry was trying to do.

39 Interview with industry manager C, near Detroit, Mich., December 14, 1999 (name withheld on
request).
40 This paragraph is based on a meeting the author had in 2000 with a one-time agency participant.
41 Derived from the author's conversations with participants at various times from 1999 to 2001.
Structural Change Within or Across Institutions

One type of interaction is slightly more abstract: the class of changes in organizations or operations that can occur within or between participants in order to facilitate ongoing or future interactions.

In the case of PNGV, some changes resulted from early, high-level organizational shifts or mechanisms defined specifically for PNGV. In 1997 Buntin noted that the PNGV Declaration of Intent directed the industry and government participants to reorganize their operations to accommodate and promote the PNGV goals: “The Declaration of Intent also stipulated that both the auto industry and the executive branch to [sic] reorganize their own operations in order to meet PNGV’s goals. The auto industry had perhaps the easier task, since the existence of USCAR provided a ready-made organization for the Big Three to work together.”42

As an example of a PNGV-specific organization, PNGV’s Operational Steering group provided coordination and oversight roles. An industry representative noted the utility of this interagency and inter-sector group: “The Operating Steering Group forces the government to talk to each other, get their act together.”43

Another body established specifically for PNGV was the National Research Council’s peer review committee. A government participant expressed the value of this function: “Peer review has helped. They ask questions about things and don’t let go until they are answered. The process helps take in all perspectives of management and

42 Buntin, 1997, p. 16. Part of this quotation also appears in Chapter 9.
43 Interview with industry manager D, 1999.
the tech teams together.”44 Together, these sorts of organizations created or modified by PNGV helped to improve or assist interactions from then on.

In a more general case, the technical teams and consortia associated with PNGV and USCAR were structures created to provide a standard and streamlined format and venue for discussions. Consortia also helped streamline the legal mechanisms associated with coordinating across companies and sectors. In the context of companies coordinating with national labs, one industry participant noted: “PNGV provides an organization that companies can get to without hindrance. You don’t need new timelines or separate agreements negotiated each time.”45 This same individual noted that such improvements also help companies coordinate their activities better: “PNGV allows a flow or implementation path within their own companies. Without it, it’s very difficult to transfer an idea to their companies. So PNGV serves as both technology and policy in assisting in the transfer of technology.”46

Also, as noted in Chapter 9, the physical relocation of the USCAR headquarters from Dearborn to Southfield provided mutual convenience and symbolic neutrality.

While the existence of organizational or structural changes may be clear, there were few direct statements crediting particular organizational for improvements in the relationship. Most favorable aspects of the organizational structures created through the partnership were implied among the statements participants made identifying the benefits of improved communication and coordination. However, taken together, the statements quoted in this section and the apparent success of PNGV’s communication and

44 Interview with government manager D, 1999.
46 Interview with industry technical staff C, 1998. This quotation also appears in Chapter 9.
coordination roles (discussed above) point to the success of the organizational shifts in facilitating that communication and coordination.

**Preliminary Outcomes**

A preceding section of this chapter introduced the concept of a relationship as a cycle of interactions among partners. The value and health of the relationship may be measured by what the cycle yields, both in its primary outputs, but also in various secondary outputs and side effects (shaded in Figure 10-5, as (C)). One set of these may be considered to be preliminary outcomes, including a mix of primary outputs and secondary effects.

![Figure 10-5: Outcomes of Interactions in Institutional Relationships](image)

In the case of PNGV, these included technical results, as well as more subjective effects, such as a change in the nature of the interaction or an improvement in the understanding among partners. Some of these outputs were observable from the outside, while others were less obvious or more difficult to discern, and they may have served mostly as indicators of how well the participants were working together.
Technical Results

A primary metric of the effectiveness of the technical interactions is the extent to which they were meeting their technical goals. Without assessing specific technical results of the partnership, many of the participants proudly discussed the many technical solutions they jointly accomplished over time. By most metrics, including that the vehicle prototypes for each of the Big Three appeared on schedule through 2000, the technical successes of those involved was easy to verify.

Some participants felt that few of the technical results of PNGV were individually groundbreaking, such as this industry representative: “There’s been no ‘aha!’ change of direction in any of these areas.”

However, this same individual noted that PNGV facilitated and sped the advances the technical advances the participants made: “PNGV has definitely facilitated the process, but there are no breakthroughs. There are, however, solid technical advances. Many of them would not have happened as quickly without PNGV, though you can’t claim they would not have happened at all without PNGV.”

Indeed, whether these advancements or other similar results would have happened without the partnership is not as easy to demonstrate. As one industry participant noted: “There’s the historical dilemma of tech transfer – who takes credit? There’s also the Not Invented Here factor – often, you have to make the other person think it was their idea. The question is, how can PNGV take credit for things being developed together.”

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47 Interview with industry technical staff H, 1998.
48 Interview with industry technical staff H, 1998.
49 Interview with industry manager E, 1999.
Some participants and observers pointed to the hybrid vehicles available for sale by other OEMs as proof that PNGV was unnecessary to yield new technologies. However, even setting aside the argument that the Toyota and Honda hybrid-electric vehicles might never have been developed without the threat PNGV posed, it is not difficult to demonstrate that the other vehicles years later still do not achieve the more ambitious PNGV goals. While it is impossible to say that the Big Three would not have focused on vehicles and associated technologies similar to those that PNGV would demand, it is clear they were not conducting major efforts to develop them prior to PNGV.

General Motors’ development of the EV-1 electric vehicle is one example, which may have been prompted by the ZEV mandate that California implemented. However, it is important to note that PNGV was a high-level shift from earlier government policies for alternative vehicle technologies, which had emphasized electric vehicles.

Finally, another result of any research program goes beyond what you succeed in developing: research also has to do with gaining understanding. One industry participant demonstrated awareness of the value on improved understanding in assessing the outcomes of PNGV: “Progress does not equate to success. Proving or disproving technologies are equally important.”50 That said, while improved understanding of what doesn’t work is important and may even be an implicit goal of any research program, the explicit PNGV technical goals had only to do with proving and prototyping successful technologies.

50 Interview with industry manager D, 1999.
Results of Interaction

Beyond the technical results, increased interactions may also yield other changes that can affect further interactions, such as transfers of funding, technology, or expertise. Generally, these are not outputs that anyone outside the partnership notices, but rather are results of the interaction that enable other aspects of the interaction to occur. Without dwelling on these, it is important to note they exist, as these factors enable further interactions and influence how the participants view the ongoing partnership.

For example, certain interactions between parties can result in a transfer of resources. In addition to the simple transfer of funds, this can entail a sharing of information or technological concepts. Interactions can also result in propagation of standards or changes in regulation.

Eventually, interactions can yield changes in individual behavior, for example, breaking an existing cycle of regulation, appeal, and lobbying by presenting a more productive alternative. Unfortunately, it is hard to identify examples of what did or didn’t happen relative to what might have happened otherwise. For example, while the antagonism appeared to have lessened during the time of the Partnership, it is hard to say the Partnership was responsible. Similarly, it is hard to say if any such changes of behavior were based on the productivity of the relationship, as opposed to some more direct benefit the participants derive in going along with the interactions (such as a relaxation of regulation).

Perceptions and Understanding

Another potential outcome is an increased understanding of the others in the relationship. There are several possible types of understanding that can be gained,
including understanding what others are trying to achieve, understanding the difficulties and constraints others face, understanding ways in which others function, understanding how others may act or react, and understanding how one is perceived by others.

Improved understanding of others can help dispel prejudices one group holds of another. To the extent the partners have common motivations and goals, improved understanding can reduce the antagonistic perceptions of “us” versus “them.”

Many participants observed aspects of improved understanding. At perhaps the simplest level, one journalist highlighted the fundamental gain in the simple understanding of how disparate partners in government and industry can work together: “PNGV also has made progress in an intangible area. Government and industry have found a way to work together on a very large project.”

While this may sound trivial, the many statements on the historically antagonistic relationship support that this may be a meaningful improvement.

One industry representative interviewed stated: “The partnership helps [the participants] understand each other’s perspectives.”

More specifically, Larry Howell General Motors’ executive director for science, trumpeted the value of how the partnership has spread understanding among PNGV participants: “The PNGV partnership yields additional benefits by improved working relationships between industry and government. Government agencies can understand our issues, such as those involving customer acceptance.”

51 Hileman, 1997, p. 31.
52 Interview with industry technical staff A, 1998.
saw that the relationships developed through PNGV had provided the government with greater understanding of what industry needs to do.

Finally, another industry participant agreed with this concept, noting further that this type of understanding was not unique to this type of relationship: “We’re still learning the lessons of the partnership. In some ways, it’s analogous to our corporate lives. You recognize that you have different perspectives and needs, and you do a lot for the sake of building relationships. One difference is that other jobs you have to do may take priority.”

The speaker indicated that the recognition of others’ perspectives and needs is similar to the insights one gains when working with coworkers. However, the latter part of the quotation indicates that the conflicting allegiances and responsibilities were generally worse when working across corporate boundaries.

An analyst noted another, larger result of the partnership on understanding among partners: “For the government people, the most educational aspect is the opportunity to learn firsthand the difficulty in meeting PNGV goals and to realize that no easy solutions are sitting on the shelf, with only the recalcitrance of the companies standing in the way of their introduction. This may be the most beneficial aspect of PNGV.”

While part of this explanation echoed the statements of the benefits of the technical interaction on understanding the technical challenges, this analyst further observed the resulting understanding that industry recalcitrance alone cannot explain the slow development and adoption of improved technologies. Johnson indicated that this may be a particularly beneficial outcome of the partnership.

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54 Interview with industry technical staff D, 1998.
On the government side, President Clinton’s Science Advisor John Gibbons made similar observations on the understanding gained among participants. He described the preliminary result at the 1994 hearing before a subcommittee of the House of Representatives:

“In building this partnership, we had to take a lot of time, time to build a sense of trust and understanding about the common goals and the relative roles for the public and private sector… Now the key to the partnership then is a historic agreement based on unprecedented cooperation and trust between industry and the Government to mutually pursue three interlocking goals…”

Dr. Gibbons’ statement that trust and understanding were key to the partnership indicates the priority placed on the attitudes among the partners.

Another government representative reached a similar conclusion:

At the policy level, I really think [PNGV] had a big effect. You can’t spend a lot of time with somebody and listen to what they’re doing without gaining an understanding of the issues they face. As far as the adversarial relationship, I think they’ve made some progress on it. The sort of interaction government and industry have gives the other side a more human face.

A subsequent section of this chapter provides further detail regarding the path from understanding to changes in attitude, such as increased trust.

**Effects on the Relationship**

The preceding sections have dealt with the mechanisms of coordination and the preliminary outcomes of the coordination. The rest of the chapter is a discussion of the effects of the coordination on the relationship itself. While the mechanisms discussed can lead to tangible outcomes, these outcomes can translate into positive or negative effects on the relationship itself. It is these effects that enable improved interactions in

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57 Interview with government policy official B, 1999.
the future, which in turn can yield further effects on the relationship. Even in a very good relationship, it need not be the case that every interaction yield positive effects, but rather that the interactions will continue to be sought if the balance of the effects should remain generally positive.

One type of effect on the relationship is a shift in attitude of each partner toward the others. Indications of shifts may be derived from statements observing the shift or from actions that demonstrate it. A related effect – perhaps a special case of improved attitude – is an improved level of trust among partners. This discussion fits into Figure 10-6 as component (D), shaded.

**Figure 10-6: Effects of Interactions on Institutional Relationships**

Taken to an extreme, very positive shifts in attitudes and trust can cause the partners to make tangible shifts in how they function, to better align their goals or resources to better accommodate their partners’ goals or use their resources. A level of trust is required for the leap of faith necessary when a partner invest its own infrastructure and resources based on an expectation for continued beneficial interaction.
Finally, stated or demonstrated willingness to continue or start other cooperative efforts together may be interpreted as an indication of particularly positive attitudes about the other partners and the existing interactions.

Trust

From the start, trust was an issue across many of the partners. An industry participant interviewed observed that the partnership was based more on a handshake than any signed document: “The partnership is really just a gentlemen’s agreement between USCAR and the government.”

A government partner made a similar statement: “The Declaration of Intent was never signed – the effort is based on the good faith of the participants.” While the lack of a signed agreement could be taken to indicate the tenuous nature of the agreement struck, some point to it as an indication of the comfort of the partners from the start.

The first of the NRC peer reviews highlighted the role of trust in making the partnership ultimately succeed. “[The PNGV program] relies on mutual trust and strong motivation of the partners to make the program succeed.” The NRC perceived early in the process that, if only because of the broad goals, that it would be necessary for the partners to develop a level of trust in order to commit to the partnership as necessary.

Finally, an industry partner noted in an interview the extent to which the interactions were based in the particular relationships developed among specific individuals: “Almost by design, the partnership is matrixed – very much relationship-

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58 Interview with industry manager D, 1999.
60 NRC, 1994, p. 17.
based. It is designed to streamline the process, not look good on an org chart.\textsuperscript{61} This quotation provides an interesting way to think about the interactions between individuals. A so-called matrix organization is one in which the members are organized in multiple ways, depending on the context. For example, while they may belong to a particular department and division on an organizational chart, they may also organize based on other, cross-cutting factors, such as discipline or current targeted effort, bringing people together from distinct parts of the organization(s). Such alternative arrangements may be temporary, based on a passing need, or they may be semi-permanent, to permit an organization to respond to different types of needs at different times. Conversely, a non-matrixed organization retains a set of one-to-one relationships between employees. The observation that PNGV was matrixed demonstrates an awareness that each participant maintained multiple types of relationships with other participants, depending on the context.

There are benefits and drawbacks of the relationship-specific interactions the speaker identified. This observation suggests a certain bond built between individuals that they would trust one another more than usual. On the other hand, it also highlights the fragility of these relationships – if either individual leaves his or her current role, the particular relationship may be lost.

New Attitudes Part 1: \textit{Automotive News Opinions}

Detecting and documenting changes in attitudes or perceptions among participants is not easy, as announcements of changes in attitudes were rare. In addition

\textsuperscript{61} Interview with industry manager D, 1999.
to personal interviews with PNGV participants, one method is the find indicators of larger shifts of attitudes in the industry.

While there is no way to definitively gauge the shifting views of the many players in an industry, one reasonable indicator of these views is the press. Within the automotive industry, there are various journals that regularly report on different aspects of the automotive industry. Some, such as *Road & Track* and *Motor Trend*, are geared toward the automobile enthusiast, while others, such as *Automotive Engineering*, are written for engineering and technical specialists in the industry. A third group of journals, including *Automotive Industries*, *Automotive News*, *Automotive News Europe*, *Automotive News International*, and *Ward's Auto World* provide news, opinion, and statistics for general industry readership.

With over 80,000 subscribers, *Automotive News* is the largest circulation weekly publication on the auto industry. Each week, publisher Keith Crain expresses his views on significant issues and events in his Opinion column. This presents a set of archived snapshots of attitudes of a well-read voice in the auto industry.

These weekly *Automotive News* columns provides some interesting trends, such as three cumulative totals shown in Figure 10-7. Plotting the positive or negative opinions over ten years of columns highlights some long-term trends in attitude, as well as periods of time in which certain attitudes prevail. The overview of Data and Methods in Chapter 6 provides details on the techniques in coding and plotting these data, in addition to considerations of their limitations and potential biases.

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Figure 10-7: Cumulative Counts of Categorized *Automotive News* Opinions

The figure demonstrates one thing quite clearly: in general, the three types of opinions do not follow the same trends. The following paragraphs discuss in turn opinions tracked for regulations, the administration, and PNGV.

The “regulations” line throughout is a mixture of positive and negative. This makes sense in part because the regulations covered a mixture safety, emissions, efficiency, and other topics.\(^6\) Crain understood the position of the automakers, but his tone was generally moderated by what was good for the auto industry as much as individual automakers. The resulting mixture of positive and negative opinions (averaging out to a slightly negative trend over the years) highlights that he felt that not

\(^6\) Crain also similarly expresses a mixture of agreements and disagreements with the federal government over time, though it is unclear at times whether such opinions are meant to apply to the executive branch and which to the legislative branch.
all regulations were bad or good. There are certain rises and dips evident, which are explained more fully below.

Some of these mixed opinions, for example in late 1997, may reflect a tendency of Mr. Crain and of opinion columns in general to make statements based on particular events or policy changes. Indeed, dramatic increases in PNGV-related articles in periodicals occurred immediately following the publication of the NRC’s peer reviews and at the beginning of each calendar year, around the time of the auto shows (especially in Detroit).

The “administration” line tracks opinions specific to the Clinton administration. The line shows fewer expressions of opinion, and is generally flat, outside of a single, year-long positive trend, corresponding to an early period in the Clinton administration (and the first year of PNGV). Overall, this line seems to indicate tentative opinions giving way to a dramatic run of positive opinions toward President Clinton during a specific period of his early presidency, and little change thereafter.

The “PNGV” line, which does not include prior government automotive research or subsequent FreedomCAR efforts, is a mix of neutral and positive statements, resulting in a line that steadily increases over the years. Some of Mr. Crain’s neutral opinions were of a tentative, “time-will-tell” nature, but over time he was consistent in expressing encouragement for the intent – if not the execution – of the partnership.

Figure 10-7 shows a good deal of activity late in 1993, which seems to be influential in causing the three lines to diverge. After an initial period of neutral and mixed opinions in all three areas, suddenly the administration and PNGV lines both shift
positively. To provide more understanding of this period, Figure 10-8 shows the period between May 1993 and June 1994 on a finer, monthly time scale.

![Graph showing data from May 1993 to May 1994]

**Figure 10-8: Detail of Automotive News Opinions from May 1993 to May 1994**

Through the November 1993, there were seven references to the administration, which were mostly positive. Three of those seven were also relevant to PNGV. Then, in rapid succession, December and January had four more references about the administration and/or PNGV, all of which were positive. In all, about half of the positive press for the administration was linked to positive statements about PNGV, and much of the positive press for PNGV was within a period of a little over a month.

To understand the significance of the cluster of positive statements, we will examine what was going on at that time. In the first, Mr. Crain discussed the outlook for new cooperation among the Big Three and government, responding in part to a *Time*
magazine cover of the prior week, featuring the heads of the Big Three.64 In the second, Mr. Crain reflected upon a strange year when, among other things, “we have a level of government-industry cooperation that has never been seen before.”65 In the third, Mr. Crain listed 18 reasons why 1993 was a good year, including, at number six, the President’s interest in working with the industry to solve societal problems.66 And in the last, Mr. Crain reflected upon President Clinton’s first year in office.67 Across these, we can see some reiteration of opinion provided not based on new events or information, but rather end-of-year and anniversary wrap-ups. If we were to completely ignore the last three positive assessments (which in our charts would shift the Administration and PNGV lines down by three points), the divergence in Figure 10-7 between the “PNGV” and ”administration” lines and the “regulations” line would still be notable.

Together, these divergent lines suggest that attitude toward regulation (in a general sense) wasn't a primary motivation for attitudes towards the Clinton administration or PNGV. Similarly, a more static review of the administration doesn't seem to be carried over to the PNGV-relevant line, which makes sense as the administration line is subject to opinions on any number of administration policies.

Note that some of the apparent trends in these lines are sensitive to the way this assessment was set up. For example, if the assessment started in mid-1994, the increase of the “administration” line would be much less apparent. Similarly, it is possible to select specific year-long periods in which the regulation line is generally increasing, and others in which it is generally decreasing. However, the period shown in Figure 10-7 was

64 Crain, December 13, 1993, p.12.
chosen to try to separate out opinion of these three areas during a specific, significant period: the course of the Clinton administration.

New Attitudes Part 2: Other Data Sources

In addition to focusing on Crain’s Opinion column, analysis of the coverage of PNGV in other *Automotive News* articles provides more insights on the nature of *Automotive News* than on PNGV itself. For example, a look across all PNGV-related articles in *Automotive News* from 1992 through 1999 yields very few value-based opinions on PNGV outside of the Crain’s column. Of those, all were found in “Comment” columns, an intermittent feature immediately following the Opinion page in which guest industry executives and experts provide their perspectives on some topic. Other articles quoted or paraphrased quotations of PNGV participants, Big Three executives, and industrial and environmental interest groups, but otherwise very few editorial opinions appeared. The few statements that were value-laden were tentative, or had a “wait-and-see” flavor, all of which would receive a “0” rating on the scale used in the opinion column analysis, above.

Another possible indicator of industry attitudes is the local or regional press. Since the Big Three have long been headquartered in the Detroit area, a local Detroit newspaper was selected to gauge overall attitudes towards PNGV. This assessment differs from the preceding search on *Automotive News* editorials in several ways: Since *The Detroit News* is a daily newspaper, the prospect of reading every paper for attitudes towards PNGV and regulations and the Clinton administration would require much more

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effort than the weekly editorial pages of *Automotive News*. So instead of thoroughly reading through each issue, a search for specific terms relevant to PNGV was performed, but that precluded the ability to compare *The Detroit News* attitudes towards PNGV with those expressed on topics of government regulation and President Clinton.68

Figure 10-9 displays a cumulative chart of the results of the searches over the 1992 to 1999 period. Valid hits from the searches were few and infrequent.

![Detroit News Opinions on PNGV](image)

**Figure 10-9: Cumulative Counts of Coded Opinions from *The Detroit News***

The editorial page was the source of all four of the negative comments. Of these, most comments focused on PNGV as a case of corporate welfare. Some articles praised the early indications or potential gains of the partnership. At least one of these positive articles appears to be in response to a prior negative editorial. For the most part, covering

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68 Details of search construction are in Chapter 7.
of the partnership in *The Detroit News* was neutral, including all reports since early 1995. In general, the very few points of data relative to the *Automotive News* analysis demonstrate a general lack of awareness or interest even in the local press, which suggests that the industry press is the only practical source for an assessment of the industry attitude.

**Willingness to Continue**

The willingness that both government and industry had to participate in a partnership arrangement were rooted both in the history of past interactions and in the potential benefit of cooperation perceived by each group. Each interaction between government and industry affected their willingness to work together on a continuing basis, in part from the effectiveness of the interactions in achieving their purpose. Additionally, the willingness to work together on a particular effort may have affected eventual willingness to work together on other efforts. This willingness provides an indicator not only of the value experienced by the participants in the interaction, but also of the attitudes the participants had towards one another.

Specific to PNGV, the history of past interactions between government and industry would affect the willingness to participate, possibly both positively (both parties may have seen the antagonism as counter-productive) and negatively (antagonism may well have prompted caution). It is true that this antagonism did not prevent the partnership, but representatives from both government and industry expressed a high degree of caution or concern for the proposal.
As Chapter 8 introduced, during the course of the partnership, the evidence suggests consistently strong interest in continuing it, as well as evidence of interest in further partnerships and other interactions.

For example, Ron York of General Motors expressed his enthusiasm:

We welcome the opportunity to work with our government in this new spirit of cooperation toward goals of such importance to our nation. We believe that this constructive partnership approach to solving problems together will be immensely more effective than the adversarial relationship of the past, and hope these efforts will be the basis for a New Generation of Cooperation between the public and private sectors of the United States.\(^69\)

Years later, with much more experience with the partnership, York added:

“PNGV also has made progress in an intangible area… Industry and government have learned to collaborate in an effective and responsible way on something of great significance to the country.”\(^70\)

A government PNGV manager had similar thoughts of the PNGV interactions: “I hope we find ways to continue to work together.”\(^71\)

Willingness to work together might also be represented by discussions of future arrangements between government and industry. One such example was a parallel partnership involving heavy trucks, and another addition to PNGV that might have involved SUVs. Specific to the industry partners, as discussed in Chapter 9, the Big Three appeared in be increasingly willing to continue to cooperate with competitors or non-traditional suppliers.

Using a sense of continued interest in PNGV and further interest in other partnerships is an imperfect indicator. It is difficult to characterize relative willingness.

\(^{70}\) Quoted in Hileman, 1997, p. 31.
Participants may state without true commitment that they would like to continue the interaction or that they would be interested in future interactions. One may be able to observe apparent interest in participating in further interactions. One can note subsequent interactions and presume that they were due in part to the effectiveness of the current and prior interactions.

Using willingness as an indicator is also problematic because working together, or feeling inclined to work together, may not be based purely on the stated goals for the interaction. If the participants in PNGV continue to participate primarily for a benefit in public relations, then their willingness to participate may not be based on the effectiveness of their interaction or on their attitudes towards one another. And the motivations or benefits experienced by one participant do not need to match those of other participants for all of them to want to continue to interact.

However, it seems unlikely that any of the participants would put in the amount of funding and effort that they did strictly for the sake of public relations. In fact, for a given OEM, public relations might be better sought through its own investments and publicity, instead of coordinated funding and efforts. Therefore, while public relations may have been a factor, there were enough other motivations that would seem to align the participants towards some common goals, and the evidence of continuing funding and effort spent in coordinating with other participants toward those goals suggest that the participants found their interactions to be useful.

Nevertheless, while one may identify other explanations for apparent willingness to participate, the most likely explanation is that the participants saw value in further

71 Interview with industry technical staff A, 1998.
interaction, and that the participants had positive attitudes towards one another at some level. This most likely explanation is further supported by the quotations and assessments already discussed.

This discussion ends with one more quotation from 2002 from Vince Fazio of Ford: “As these projects have progressed, the PNGV is becoming a process for technology development rather than simply a set of one-time goals.” If the PNGV approach had become accepted as a process for working together to develop technology regardless of the specific PNGV goals, that may have been the greatest indication of value for the participants.

Conclusions on the Interactions among Partnership Components

This chapter shows that the effects of PNGV could be seen not only at the highest levels of companies and agencies, but also among the interactions between the components of those companies and agencies. These observations help underscore the aggregate conclusions of Chapters 8 and 9, showing more specific ways in which components and processes of the relationships among partners changed and in many cases improved during the course of the Partnership.

The chapter presents a partnership as a looping process involving motivations, interactions, outcomes, and effects. Through that lens, we can see how a given interaction among participants may have not only direct outputs, but also may assist or hinder future interactions. While some may measure the value of the partnership only by its progress and ultimate success in achieving technical goals, improvements in understanding,

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attitudes, interactions, and processes were important in themselves, as they helped enable
the success of future endeavors between government and industry.
CHAPTER 11: PNGV IN THE REAR-VIEW MIRROR

The analysis of preceding chapters demonstrates that PNGV improved relationships among some participants, largely validating the primary hypotheses this dissertation tested. Chapter 10 explores the many components and processes of these relationships to provide a better understanding of how the relationships improved. This chapter provides an epilogue for this analysis, viewing through the passage of time the significance of what PNGV achieved and what it failed to achieve, thus providing additional context for the conclusions of this research.

This discussion begins by reflecting on what has happened in the automotive industry and in federal automotive research and policy since the time of the Partnership. We pause to consider the significance of PNGV’s failure to meet its goal for 80-mpg production prototype vehicles. The chapter concludes with a discussion of the influence of PNGV and its viability as a model for government-industry cooperation.

PNGV in Hindsight

In the years since PNGV was created, much has changed in the automotive markets, in the makeup of the automotive industry, and in the technologies seen in new vehicles. Chapter 3 chronicles the changes in industry and federal policy through the end of the Clinton administration. The following discussion provides a brief analysis of events since then to provide a historical lens for the outcomes of the partnership through the dynamics and decisions that followed.
The Last Years of the Clinton Administration

In 2000, the Big Three all unveiled concept vehicles that demonstrated progress toward the fuel economy and other characteristics embraced by PNGV. These vehicles more or less satisfied the penultimate major milestone for PNGV before the Big Three were to unveil their production prototype vehicles in 2004.

But even with these concept vehicles, by the end of the Clinton administration the NRC peer reviews and at least some PNGV participants were advocating for updating the goals for the partnership. U.S. market dynamics for cars had changed during the course of the partnership, most notably shifting demand away from family sedans (a primary focus of PNGV) and increasing demand for SUVs and light trucks. As early as 1997, the NRC noted in its Third Peer Review: “[PNGV] has made some very promising strides, but the Panel believes that work needs to be supplemented by technology initiatives for larger vehicles, sport utility vehicles, light and heavy-duty trucks.”  

In 1998, following his departure from the program, long-running chairman of the PNGV Technical Task Force Robert Chapman pondered, “So, with an increasing number of ‘gas-hog’ SUVs being produced and fewer of the originally projected clean cars expected, have the PNGV’s attentions been misplaced?”  

Shifting to the topic of whether and how PNGV might continue in the future, after the scheduled completion in 2004, he opined:

With regard to the unresolved technical problems or a desire to push on to higher levels of accomplishment, it would seem wise to negotiate a new partnership agreement. This would allow a clear focus on remaining problems and on what the appropriate roles for government and industry should be. It should also yield a better agreement in that the experience with the PNGV would be a guide…

1 PCAST, 1997, p. 36.
new agreement could also lead to a rethinking on the government side of how best to support such a partnership.³

By the time of the seventh NRC review in 2001, their recommendations had become even clearer than before. The following excerpt underscores both their support for PNGV activities and their call for revised goals:

The committee believes that the PNGV program has established a unique and valuable framework for directing closely coordinated industry and government research efforts toward the development of technologies capable of solving important societal problems. These efforts have resulted in a number of significant technical successes to date. It appears, however, that the current context of the partnership is sufficiently different from that in 1993 to warrant a reconsideration of its specific goals.⁴

Regarding the changes in the “context of the partnership,” the review referred specifically to several factors, including: increasing concerns for climate change associated with greenhouse gases, increased demand for sport utility vehicles, U.S. regulatory changes that would likely increase fuel consumption and create barriers for diesel-based vehicles (which could affect the deployment of the PNGV diesel-hybrid prototypes), the hybrid-electric vehicles that Toyota and Honda had introduced successfully into the marketplace, and changes in the global structure of the automotive industry (which could shift how one thinks about the competitiveness goals originally envisioned for PNGV).⁵

It seems clear that before the end of the Clinton administration even proponents of the PNGV approach were interested in revisiting the goals of the Partnership in the future.

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⁴ NRC, 2001a, p. 10.
⁵ NRC, 2001a, p. 10 and pp. 17-18.
The Bush Administration and FreedomCAR

The incoming Bush administration did not see the pursuit of 80-mpg sedans to be an urgent priority, and it replaced PNGV with FreedomCAR (where CAR stood for “Cooperative Automotive Research”). This was not unexpected, as it is somewhat common for a new White House to revisit the initiatives of a previous administration for possible renewal, redirection, or cancellation. By some standards, FreedomCAR replaced PNGV, but by others it simply redirected its technical thrust.

The difference? FreedomCAR shifted the emphasis of the research from incremental technology development to longer time-horizon research on hydrogen fuel cells. FreedomCAR also extended the timeline of the initiative by 10 to 15 years.6 The Bush administration also added a complement to FreedomCAR in launching the Hydrogen Fuel Initiative, which focused on improving the fuels needed by fuel cells and related technologies.

NRC summarized the transition as follows:

Building on the PNGV program, in January 2002, the Secretary of Energy and executives of DaimlerChrysler, Ford, and General Motors announced a new government-industry partnership between DOE and USCAR called FreedomCAR…. In September 2003, FreedomCAR was expanded to also include five large energy companies—BP America, Chevron Corporation, ConocoPhillips, ExxonMobil Corporation, and Shell Hydrogen (U.S.)—to address issues related to supporting the fuel infrastructure. The expanded partnership is called the FreedomCAR and Fuel Partnership.7

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7 NRC, 2008, p. 17.
Funding for FreedomCAR started at nearly $88 million in fiscal year 2003, expanding to nearly double that six years later. DOE funded hydrogen fuel research across several offices at similar levels during this time.  

The Bush administration emphasized how FreedomCAR built on PNGV’s efforts. For example, DOE Assistant Secretary David Garman said, “The Partnership for a New Generation of Vehicles accomplished a great deal. It’s not being abandoned and left by the side of the road. FreedomCAR is taking PNGV to the next level.”

Nevertheless, response to this announcement was mixed. Some were excited for more “high-risk/high-payoff research that is in the national interest” As a 2002 article in Science noted, others lamented the loss of “important near-term work” in favor of possible “benefits that we may not see for decades.” Some critics lamented the loss of specific goals and deliverables, such as PNGV’s production prototypes. For example, an Opinion in Automotive News applauded federal funding for fuel cells, but cautioned, “...the administration must set firm goals, then make sure the goals are met.” Others saw the move away from specific production prototypes as a benefit, where the advanced technologies developed could benefit all light-duty passenger vehicles.

Some portrayed the announcement as a defeat to the forces of market demand, such as Harry Stoffer from Automotive News: “The 80-mpg goal has been abandoned in the face of low gasoline prices and truck-happy consumers.” Months later, Stoffer

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12 NRC, 2005, p. 2.
shifted his emphasis to how little actually had changed with the shift from PNGV to
FreedomCAR: “The [Bush] administration came to office 17 months ago calling the
Clinton-era partnership misguided, unaccountable and bloated. A year later it proposed
to spend about the same amount of money with the same industry partners – the Big 3
and their suppliers – and to do similar research at the same laboratories.” 14

By the time of its 2005 review of FreedomCAR, the NRC cast the transition to
PNGV to FreedomCAR as a positive evolution. They noted all the ways in which
FreedomCAR was based on the PNGV framework, and then note how FreedomCAR
expanded on the scope of PNGV:

[Unlike] the PNGV program, which aimed at the development of concept and
preproduction prototype automobiles, the FreedomCAR and Fuel Partnership
addresses the development of advanced technologies for all light-duty passenger
vehicles—for example, cars, sport utility vehicles, pickups, and minivans. Another strength of the new partnership is that it includes fuel production and
infrastructure technologies and that it includes five energy companies, adding
essential knowledge about fuels to the program. 15

Whether or not the shift from PNGV to FreedomCAR represented an evolution or
revolution, one thing was soon clear: the Big Three would not be expected to meet the
PNGV goal for fuel-efficient production prototypes by 2004. The significance of the
failure to meet this primary PNGV goal is explored immediately following the next
section.

More Changes in the Obama Administration

Even before the inauguration, the Obama administration was immediately faced
with addressing the economic crises of 2008. Among of many elements of the

challenging economic situation was the dire situation of the domestic auto industry. The credit crisis and high gasoline prices led to a decline in motor vehicle production to the lowest levels since at least 1967. The Big Three were hit particularly hard, as gas prices led to shifts in consumer demand away from the SUVs and light trucks that dominated their sales in favor of more efficient vehicles. In 2008 Gerald Meyers, a former chairman of American Motors Corporation, noted, “In the early ‘70s, we were caught flat-footed, without smaller, fuel-efficient cars. We had nothing to sell... That’s exactly what’s happening now.”

Chrysler and General Motors applied for bankruptcy protection in 2009. In the end, the federal government provided General Motors with $50 billion and Chrysler with $7 billion, and both companies underwent restructuring to pare back excess capacity. By the end of 2009, General Motors, which had been the world’s biggest automaker until 2008, will be majority owned by the U.S. Government and will sell some or all of its interest in certain brands such as Saab and Hummer.

In its first budget request to Congress, the Obama administration made it clear it was scaling back much of the hydrogen fuel cell research that had been the centerpiece of FreedomCAR. To explain the cuts to fuel cell research, incoming Secretary of Energy

Steven Chu stated that fuel cells would not be practical for at least the next 10 years, and the government would pursue efforts that could have more immediate impact.\(^{21}\)

To some, this was good news. One *Automotive News* analyst saw this as a good opportunity to return to raising CAFE standards: “Last week when President Barack Obama whacked President George Bush’s $1.2 billion initiative to develop hydrogen as a viable fuel for automobiles, he ended decades of political subterfuge that kept Washington from raising corporate average fuel standards.”\(^{22}\)

Others questioned the wisdom of scaling back fuel cell research to the extreme proposed in DOE’s budget request. In a July hearing of the Subcommittee on Energy and Water Development of the Senate Committee on Appropriations, Subcommittee Chairman Byron Dorgan from North Dakota said, “The department's made a significant mistake here… If somebody is going to look at things that are...essential in the longer term, who but the Department of Energy should do that?”\(^{23}\)

Similarly, the National Research Council committee that had been assessing FreedomCAR wrote in a letter report: “The committee recognizes and agrees with the new administration’s focus on nearer-term technologies. However, it also emphasizes the need for continued investment in longer-term, higher-risk, higher-payoff vehicle technologies that could be highly transformational with regard to reduced use of petroleum and reduced emissions.”\(^{24}\)

In September 2009, the Obama administration proposed new regulations that would limit vehicle greenhouse gas emissions and would require a 40-percent improvement in fuel efficiency for cars and light trucks by 2016. Originally announced in preliminary form in May, these new rules were endorsed by automakers, states, and many environmental advocates as they provided compromises to harmonize conflicting laws and regulations across the states.25

These new regulations were followed shortly after by the administration’s release of “A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs.” In outlining the administration’s innovation agenda, the document referred to “certain sectors of exceptional national importance where the market is unlikely to produce the desirable outcomes on its own,” including as one of its three examples the manufacturing of advanced vehicles.26 In summarizing its strategy in that area, the document stated: “The President’s strategy is to put the U.S. at the cutting edge of the advanced vehicle technology industry, which will not only reduce our dependence on oil, but will also create jobs, strengthen our manufacturing base, improve the quality of the air we breathe, and offer consumers greater safety, performance, and choice.”27

To achieve this strategy, the document highlights:

- Investments and tax credits for batteries, electric and plug in vehicles, and transportation electrification;
- A $25 billion Advanced Technology Vehicles Manufacturing Loan Program;
- Grants and loan guarantees for biofuels;

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- A national autos program to pursue regulation for both fuel economy and greenhouse gas emissions.

This last regulatory policy will, the document suggests, “spark innovation in more fuel-efficient vehicles, reduce pollution, and promote energy security.”

These policies appear to depart from the partnership model established in PNGV and largely renewed in FreedomCAR, and they move to an approach to advance alternative technologies through a diverse set of grants and other direct investment, tax incentives, loans, and regulation.

Analysis: the Failure of PNGV to Yield Production Prototypes

After PNGV gave way to FreedomCAR, there were many criticisms that PNGV had failed. For example, one Automotive News analyst noted that “Some now view [PNGV] as an expensive failure because no Detroit automaker used what it learned to produce a super-fuel-efficient car. And all three automakers were beaten to the market with gasoline-electric vehicles by Toyota Motor Corp. and Honda Motor Co., which were not part of PNGV.”

In his Opinion column in Automotive News, Keith Crain was even blunter: “The government spent about $1.5 billion on the Partnership for a New Generation of Vehicles during the Clinton years – and produced what? That program tried and failed to produce a commercially viable 80-mpg family car.”

Automotive policy researcher Daniel Sperling observed: “As PNGV was pushing efforts to build a prototype for a high-tech diesel sedan, Toyota and Honda (who were not

part of the initiative) raced far ahead of the U.S. companies in commercializing hybrid electric vehicles.”

In assessing these critiques, we first consider why the automakers did not complete the 2004 PNGV goal for 80-mpg production prototypes, given that they had more or less had met the penultimate PNGV goal of fuel-efficient concept vehicles by 2000.

From the automakers’ perspective, the issue was less about the state of technology than it was about cost. The automakers were highly aware of the magnitude of investment needed to build up from concept vehicles to production prototypes. In 2002 the Chicago Tribune ran a lengthy three-part analysis of the end of PNGV, which characterized the problem as follows:

The concept Supercars had been relatively inexpensive – about $5 million to $30 million apiece – as the goal was simply to prove that it was technically possible to achieve 80 miles per gallon. But production prototypes were a significantly different undertaking. Those cars needed to show that they could be mass-produced, requiring the companies to spend hundreds of millions of dollars to retool assembly lines. The automakers did not want to make that investment for a product they weren't sure was going to sell—particularly now that sport-utility vehicles and pickup trucks were the most popular passenger vehicles in the nation, with sales in the hundreds of thousands per year.

If the automakers had expected significant demand for the results of their efforts, perhaps this cost would not have seemed prohibitive. But it seems clear they were unsure of the demand for fuel-efficient sedans the PNGV goal called for.

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32 Blackman et al., “Supercar: The tanking of an American dream; Part 3: Hitting the brakes” (from a three-part series), *Chicago Tribune*, December 8, 2002, p. 1. (“Supercars” is the term the series used to refer to the PNGV 80 mpg vehicles).
In addition, approaching the efficiency and performance goals for PNGV was technically possible, but they could not do so without additional costs per vehicle. Assuming the car companies would use the standard approach of passing added costs to the consumer, these costs would set prices for the PNGV vehicles at levels much higher than conventional models. For example, Chrysler estimated a premium of $7,500 per vehicle. These higher prices translated to greater demand uncertainties for the automakers.

In fact, at the time some thought that there was little reason to expect consumers to pay any premium for fuel-efficient vehicles. A PNGV document notes how this expectation was built into the PNGV philosophy: “Because U.S. fuel prices are among the lowest in the world, few consumers are willing to pay more for advanced technologies that provide greatly increased fuel economy, PNGV is trying to make these technologies cost no more to own than those found in today’s conventional vehicles.”

Years after he was Ford’s PNGV director, Robert Mull was paraphrased in Automotive News to say that a production prototype would have been too expensive to produce and sell, especially given the price of fuel at that time was “less than a bottle of water.”

Note that there can be strategic reasons for a company to absorb some of these costs. Indeed, initially Toyota reportedly absorbed losses associated with Prius hybrid

36 Truett, 2006, p. 18.
vehicles it sold – by some accounts at levels of $20,000 or more per vehicle. The Big Three were either unwilling or unable from a financial perspective to pursue the risks associated with this strategy. Robert Mull said that Ford couldn’t do what Toyota did because hybrids “…don’t make money, and [Toyota] can afford it better than other companies could.”

In a 1997 *Automotive News* opinion column, Keith Crain said, “None of the Big 3 want to eat the losses Toyota has with the Prius…. Eating those losses may be the price of leadership.”

Regardless, it is clear that PNGV did not succeed in achieving its goals for 80-mpg production prototype vehicles. The industry was reluctant to produce them, and ultimately the government dropped them as a goal in the transition from PNGV to FreedomCAR. At the beginning of this section we saw that some dismiss the Partnership for this reason, but does it suggest that PNGV’s cooperative partnership approach was fundamentally flawed? The successes noted throughout this dissertation and the fact that the cooperative approach was retained in FreedomCAR suggest that this is not the case. Instead, perhaps there were flaws in PNGV’s goals and perhaps missed opportunities in policy approaches the government could have used in parallel with PNGV to reinforce market demand and otherwise motivate industry production of more efficient vehicles.

Finally, regarding concerns for the cost of PNGV, it should be noted that the PNGV program was funded largely through preexisting funding for automotive

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technology R&D at DOE and other agencies. Indeed, the lack of dramatic funding increases for the program was noted as a concern of various analysts and perhaps was a reason the Partnership was not more successful.\textsuperscript{40} Regardless, an assessment of the dollar cost of PNGV should be relative to prior federal funding levels for automotive R&D.

One could make an argument that PNGV carried costs of pursuing the PNGV goals, rather than other automotive technology challenges that could have been more effective. Assessing these sorts of opportunity costs is difficult in any circumstance, and is well beyond the scope of this dissertation.

\textbf{The Influence of PNGV}

In addition to certain successes demonstrating technologies and relationship building, some external effects of PNGV are also worth noting. First, during its lifetime, PNGV may have had a broad impact on the market for alternative vehicles. Second, PNGV had some influence as an organizational model, both during its lifetime and since.

This dissertation cannot with any rigor hope to prove or disprove the influence of the partnership on the market or on the actions of other automakers. Evidence of influence is sparse, and those questions are beyond the analytical scope of this dissertation. Nevertheless, in the course of data collection, certain statements by participants, industry analysts, and other policy analysts support the idea that PNGV was broadly influential beyond the bounds of the partnership itself.

\textsuperscript{38} Truett, 2006, p. 18.
\textsuperscript{39} Crain, October 27, 1997, p. 12.
\textsuperscript{40} See, for example, the various concerns the NRC Peer Reviews raised regarding funding and other resources. The history of PNGV in Chapter 3 includes several relevant quotations.
PNGV’s Influence on the Market for Alternative Vehicles

Some certainly believe PNGV influenced competition within the marketplace for alternative vehicles. While the PNGV partners did not produce practical, marketable 80 mile-per-gallon vehicles during the course of the partnership, some sources have suggested that PNGV was influential in the greater worldwide marketplace for cars with fuel-efficient and other advanced technologies. They suggest, for example, that PNGV was a significant catalyst in the interest we see today in hybrid and fuel cell vehicles.

First, some analysts saw PNGV as part of an international race to advance automotive technologies in the 1990s. For example, Jason Mark, transportation analyst for the Union of Concerned Scientists, observed: ‘We are seeing an environmental arms race among the auto makers.’

Similarly, Larry Burns, GM Vice President for R&D and planning, said: “The drive to produce functional hybrid vehicles is being looked at as a great technology race.”

The use of competition and market forces was by design. Vice President Gore suggested that instead of using regulations to mandate emissions reductions, that market forces could be tapped to encourage the development of efficient automotive technologies: “The better way to approach it is to find the momentum of the market forces and use them to our advantage... Right now, partly because of the PNGV program,

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41 Given the transition from PNGV and its goals early in the Bush Administration, we cannot say whether or not PNGV would have achieved these goals at its planned endpoint of 2004. The final National Academies Peer Review of PNGV was skeptical that the Partnership would meet the cost goals (NRC, 2001a, p.6). PNGV participants and the NRC Peer Reviews noted that Congressional appropriations provided less funding than agencies requested for PNGV, which logically had the effect of constraining program results.

there is a massive cutthroat competition in the world auto market to develop fuel-cell cars…. GM’s got its own indigenous development. The Japanese are coming in with their vision.”

Thus, the use of market forces was central to PNGV, and, indeed, the ultimate goal of PNGV wasn’t the 80-mile-per-gallon vehicles themselves, but rather in advancing the capabilities of the domestic OEMs to position them well in the face of a new technology race.

Clearly, to the extent there was a race, some of it was fueled by fear of losing market share or of missing out on emerging markets. Several sources indicate that fear in this case was part of what brought the stakeholders in the domestic auto industry to the table. Indeed, fear is one way that competition can provide an alternative to regulation in advancing public benefits.

Don Walkowicz, the first executive director of USCAR was quoted as observing that “whoever comes up with a vehicle that gets 80 miles per gallon will dominate the auto market in the 21st century. If Japan gets there first … it could lead to a repeat of the 1970s, when smaller, fuel-efficient Japanese cars pushed American gas-guzzlers aside, devastating the U.S. auto industry.”

Walkowicz noted both the future opportunity and the consequence of not acting: a repeat of a 1970s surge in demand for fuel-efficient vehicles, which the domestic industry was slow in responding to.

Indeed, this theme was repeated in other analyses:

What worries American automakers is the thought that after a decade of U.S.-auto industry resurgence, Asian and European automakers may once again deliver fuel-efficient, environmentally friendly automobiles to a public that won’t be able

45 Dreyfuss, 1994, p. 16.
to get what it wants from Detroit. The prospect of that happening, as it did in the fuel crisis of the 1970s, keeps U.S. automakers interested in alternative fuels.46

In 1997 the President’s Committee of Advisors on Science and Technology identified the possible role of PNGV in sparking a technology race. In a report on energy from that year they said, “In some cases, U.S. technology policy can help to spur technological innovations and research by international competitors. For example, PNGV and continued collaborative R&D on fuel cells may have convinced Daimler-Benz to invest almost $300 million in fuel cells and Toyota to invest an estimated $700 million per year on alternative-fuel cars.”47

Indeed, in 2002 the Chicago Tribune noted that some saw Toyota’s investment as being in response to being excluded from PNGV: “Some Toyota officials today downplay that rejection, … [but] others at Toyota say that being excluded clearly motivated the automaker. ‘There was a real good chance they could succeed and put us at a competitive disadvantage,’ recalls Michael Love, a Toyota regulatory affairs manager.”48

To thoroughly test this idea of PNGV sparking a technology race, one would have to show first that PNGV had initiated or reenergized international competition in alternative technologies among the automotive programs at other OEMs or in other nations. Second, one would show some sort of escalation of the technology race, in the form of competition or increased consumer demand leading to increased urgency of PNGV-like goals in this country. This urgency could manifest itself through the

priorities of the automotive partnership itself or through other priorities of federal or state
governments or of the Big Three. If true, this self-escalation effect would demonstrate
one capability the White House has in setting the agenda beyond its direct control.

While one can point to evidence that is not inconsistent with this logic, this
dissertation does not include evidence to support all logical components of this possible
effect. Full demonstration of various aspects of this logic (for example, the data
collection necessary to discuss factors outside the domestic auto industry) is beyond the
scope of this dissertation. Instead, the rest of this section provides some quotations and
observations relevant to this topic.

There have been some foreign programs that were seemingly influenced by the
goals and momentum of PNGV, such as the European Council for Automotive R&D
(EUCAR). As the sources above note, various foreign-based OEMs also successfully
developed and marketed hybrid and electric vehicles in the U.S., seemingly in response to
the original PNGV announcements.49

According to Daniel Sperling, programs in Japan and Europe were launched or
reinforced in response to PNGV. In 2001, he pondered:

PNGV's greatest effect, ironically, may have been to motivate itself indirectly.
When PNGV was unveiled to great fanfare, apprehensive foreign automakers in
Europe and Japan quickly accelerated their efforts. Many executives in European
and Japanese companies readily concede that PNGV was clearly seen as a threat,
and was the catalyst for increased investment in advanced propulsion technology
in their companies.50

49 Discussion of some such programs in Japan, the European Commission, the United Kingdom,
Germany, and France may be found in Polverini (1997). Polverini did not explicitly document the timing
of these programs that paralleled PNGV, but one graphic implies all followed PNGV.
50 Daniel Sperling, “Public-Private Technology R&D Partnerships: Lessons from US Partnership for a
This acceleration of foreign efforts, he claimed, did motivate U.S. OEMs that much further. He called this a “boomerang effect”:

From a societal perspective, this boomerang effect may have been most important, because the foreign automakers feared that this partnership between the richest country and three of the largest automakers in the world would create the technology that would dominate the future. New alliances (the European Car of Tomorrow Task Force and the Japan Clean Air Program) were formed. Toyota and Honda accelerated the commercialization of hybrid electric cars. Daimler Benz launched an aggressive fuel cell program. Ford reacted in turn by buying into the Daimler-Ballard fuel cell alliance and announcing plans to market hybrid electric vehicles in 2003. General Motors followed by dramatically expanding its internal fuel cell program, creating technology partnerships with Toyota, and buying into a number of small hydrogen and fuel cell companies. Struggling Chrysler, with its minimal advanced R&D capability, merged with Daimler Benz.51

Similarly, a 2000 Automotive News article noted that DaimlerChrysler Senior Vice President for Public Policy Robert Liberatore had said that: “…the program’s mere existence sparked worldwide competition on new vehicle technologies.”52

Chrysler Vice President Bernard Robertson also suggested that PNGV contributed to globalization by spawning similar programs in Europe and Japan.53

Paul Dean, a reporter from the Los Angeles Times, noted that “Although European and Asian laboratories had already been developing fuel cells and hybrid vehicles, many American researchers believe the work of PNGV has accelerated the efforts of overseas companies.” In his 1999 article, Dean quoted Bob Culver – then executive director of USCAR – in observing: “Inside the Big Three and the industry as a whole, there are people who will say Toyota was spurred into action by PNGV, and I think even Toyota

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will admit to some of that…. And Daimler stepped up its efforts once PNGV was announced.”54

Or was PNGV a response to threats of other countries and foreign OEMs? While PNGV may have had roles in pushing the technology race along, some suggest that it was itself a response to foreign programs and market forces. Certainly, the fears of replaying the market shifts of the 1970s never went away, but were there immediate indicators of foreign competition that were responsible for PNGV? Assessments vary in the role this played.

Some analysts simply state that PNGV was created in response to foreign programs: “The unusual partnership was formed at least in part as a response to the Japanese government’s hefty support or research and development by Japanese corporations.”55

Vice President Gore himself suggested the threat posed by foreign companies in producing alternative vehicle technologies, observing that some Japanese automakers were already selling highly efficient vehicles in 2000: “We have to recognize the importance of moving quickly [to produce more energy-efficient vehicles]…. We can hear their footsteps.”56

In 1999 testimony that was critical in characterizing the Partnership as “corporate welfare,” Ralph Nader suggested that progress shown by PNGV partners appeared to come in response to progress outside the partnership: “Progress from the PNGV

participants only seems to come in response to new announcements from non-participants – again illustrating the importance of competition.\textsuperscript{57} Whether or not one agrees with his perception that the Big Three seem to be motivated solely by the threat of competition, it supports the idea that competition is at least one factor that motivated their progress.

Other analysts don’t identify outside competition as a motivating force, but note that PNGV helped the Big Three catch up with other companies in selected technologies. For example, Sperling suggested that: “[PNGV] may have helped the Big Three close a gap with European companies in advanced diesel technology, and it stimulated some advances in fuel cell technologies.”\textsuperscript{58}

Through all of these observations, it is still difficult to say whether the Partnership and its partners were motivated by the direct and current threat of competition, as opposed to a vague fear of reliving the market losses of the 1970s. The fact remains that while the Big Three have shown signs of responding to competition, their primary markets of conventional vehicles and SUVs still far outsell the perceived markets for alternative vehicles by any measure. While the market for alternative vehicles is showing growth, there is still no clear sign of mass demand. For example, in conjunction with an interview with GM Vice President Larry Burns, a reporter from \textit{The Washington Post} noted:

But for GM to be interested in something, that product has to appeal to the corporation’s quest for that basic quality that makes the auto industry so alluring in the first place: volume. GM isn’t looking for technologies that might sell a few thousand cars or trucks. Even the success of the [Toyota] Prius, which is selling about 50,000 units a year, doesn’t do much for GM, which has delayed rolling out.

\begin{flushright}
\textsuperscript{58} U.S. House of Representatives, 1996, p. 115.
\end{flushright}
its own hybrids in a bid to develop a bigger market. GM only cares about selling millions of vehicles per year.\textsuperscript{59}

As this discussion has indicated, PNGV may have motivated the interests of other countries and other OEM in technology development and marketing. However, it is difficult to isolate the role of PNGV as catalyst, as PNGV itself was to some extent a product of existing fears and market forces. And it is hard to say whether evolving U.S. policy and domestic OEM developments acted to address subsequent competitive forces. While PNGV may or may not have been a unique catalyst, it was certainly part of a longer term cycle of market forces, government policy, and technological development that continues to promote efficient vehicle technologies.

The larger observation to draw from this is that many do believe that a federal policy did spark an escalating technology race. Regardless of the reasons for the creation of PNGV, it may be that it sparked international interest, which in turn further promoted the associated technologies domestically.

PNGV’s Influence as an Organization Model

Another way PNGV certainly was influential is in introducing a new way industry and government could work together. Recall that Chapter 3 of this dissertation shows how PNGV was groundbreaking in its scope and organization. As Chapters 8 through 10 discuss, the Partnership was successful in providing a means to achieve positive results by overcoming antagonistic deadlocks. In this way, PNGV presented a model for government-industry cooperation. This section discusses ways in which PNGV has been influential as a model in other efforts within the automotive industry and beyond.

However, a detailed examination of the extent of the influence of the Partnership on other policies and partnerships is beyond the scope of this dissertation.

Anecdotal evidence from PNGV participants and others supports the concept of PNGV as a model. Indeed, PNGV was considered to be a potential model almost from the start. For example, government managers of the Partnership, such as Mary Good of the Department of Commerce, proposed this possibility in 1994: “A spirit of partnership can replace the adversarial nature [of the relationship between the government and auto industry]… The PNGV may serve as a model for future collaborative arrangements between the public and private sectors when important societal benefits are involved.”60

In a quotation from Newsweek few years later, Vice President Gore said of PNGV, “My hope is that this will serve as a model for the kind of partnership we need across a broad range of issues – to move beyond the false choices and adversarial relationships of the past.”61

A 1998 document from the Clinton administration’s National Science and Technology Council stated PNGV’s role as a model more positively: “[PNGV] is a new model for government-industry interactions, replacing adversarial and confrontational relationships with cooperative efforts designed to preclude the need for regulatory actions through technological innovation.”62

In 2000, Henry Kelly, the one-time OSTP assistant director for technology in the Clinton administration, looked back at his role in PNGV, noting: “I can't think of one [public-private partnership] that is more important or has more potential than this

30.

60 U.S. House of Representatives, 1994, p. 35.
partnership in PNGV. It has not only yielded enormous technological advances but it
redefined the way effective government-industry partnerships can be managed."\textsuperscript{63}

In all of these cases, perhaps the government leads for the policy were optimistic
about a policy they implemented. But the concept of PNGV as a model was not unique
to government participants. At a 1996 hearing, the Big Three provided a joint statement
that included the following observation:

PNGV… represent[s] a new paradigm for government and industry to jointly
tackle problems of common interest through cooperation and mutual trust. This
program represents an important precedent for a ‘new way of doing business’
between industry and government – a quicker, more efficient, and more effective
way of reaching societal goals than the adversarial and costly regulatory
mechanisms relied on traditionally.\textsuperscript{64}

In 1999, Dennis Minano, General Motors’ vice president for environment and
energy suggested that “…PNGV is a model of how a public-private partnership can
encourage the development of technology that the public will accept – the only way to
make a real difference.”\textsuperscript{65}

In its first review of PNGV in 1994, the National Research Council also validated
the role of the Partnership as a model for government-industry cooperation:

The PNGV represents a new model of collaboration between the U.S. government
and the U.S. domestic automotive industry through USCAR. It marks a
significant departure from the traditional mode of interactions, which, for the

\textsuperscript{63} Henry Kelly, “Global Challenges - Partnering For Solutions”, 2000 Future Car Congress, U.S.
http://www.futurecarcongress.org/Henry_mon.htm
\textsuperscript{64} Chrysler Corporation, Ford Motor Company, and General Motors Corporation, written testimony
\textsuperscript{65} Dennis R. Minano, “Energy and the Environment: The Twin Challenges of the 21st Century,” The
Geopolitics of Energy into the 21st Century, Center for Strategic and International Studies, Washington,
DC, December 8-9, 1999.
most part, has relied on federal standards and regulations with little or no formal collaboration among companies or between government and the industry.66

In the preceding references, sources from government, industry, and academia all hail the potential of PNGV as a model. But to be a model in the practical sense, some element of the model should be applicable to other programs.

There are examples of other programs using the PNGV framework as a basis for their organization and policy approach. For example, during the Clinton administration, the Department of Energy proposed another partnership on advanced fuels to complement PNGV: “The Department of Energy (DOE) will coordinate other federal agencies and private industry in an advanced fuels initiative growing out of the Partnership for a New Generation of Vehicles (PNGV).”67

Other federal efforts in energy and transportation have been based on aspects of a PNGV model. Indeed, many people view PNGV as a model of national public-private partnerships. For example, citing PNGV as a model, the U.S. Department of Transportation in December 1997 created a major public-private Intelligent Vehicle Initiative (IVI).68 One analyst noted: “The era of good feelings fostered by PNGV has led the administration to launch several other more modest partnerships, including the Intelligent Vehicle Initiative and the National Intelligent Transportation Infrastructure project…”69

In 2001 the Committee for the Review of the Intelligent Vehicle Initiative, a special committee of the National Academies’ Transportation Research Board, issued a

68 Sperling, 2001b, pp. 249-250.
69 Dunn, 1999, p. 96.
letter report to the Federal Highway Administration with findings concerning the program. Among their recommendations, the committee suggested that more elements of PNGV’s organizational approach could strengthen the initiative:

The committee suggests that some aspects of the governance structure of the Partnership for a New Generation of Vehicles (PNGV) could offer a model for a more collaborative arrangement [for IVI]. PNGV has a multilevel structure; technical teams of industry and government members operate at the project level; industry directors and agency midlevel managers manage the teams; and industry vice presidents and senior agency managers set program policy and overall direction.70

This recommendation is somewhat significant, given that the PNGV organizational approach was being held as a model by one National Academies’ committee around the same time that another (through the National Research Council’s annual PNGV peer reviews) found it unlikely that PNGV would achieve all of its technical goals.

The Clinton administration also based other, non-automotive initiatives on aspects of PNGV. Deane Evans, the one time director of the Partnership for Advancing Technology in Housing (PATH), said: “The initiative [PATH] began as a federal-agency collaboration initiated by the White House and modeled after the Partnership for a New Generation of Vehicles (PNGV).”71

In all of these examples, it is not always clear in what ways the PNGV model was used specifically. Certainly, all of these examples involve bringing government and industry stakeholders together to work toward common goals. However, given the

emphasis placed on PNGV as an administration technology initiative, perhaps some of
the appeal of the “model” is that it was a priority that the administration would defend. It
is small wonder this might be a popular model that other efforts would like to emulate.

In a presentation in 2000, Robert Chapman, the original chairman of the PNGV
Technical Task Force, commented: “The PNGV can be a model for future technology
partnerships. It has been in the case of the 21st Century Truck Initiative.”72 Mr.
Chapman detailed specific aspects of PNGV that were used to create the 21st Century
Truck initiative, including clear goals with interim checkpoints, the involvement of
multiple R&D agencies with one as clear lead, the use of federal laboratory resources.
He also noted a few ways the truck initiative differed from PNGV, including the
possibility of federal procurement of trucks that would result from the efforts of the
partnership.

The case of the 21st Century Truck Initiative also illustrates how the PNGV
partnership design persisted into the Bush administration. David Garman, Assistant
Secretary for Energy Efficiency and Renewable Energy echoed the value of the PNGV
design in the continuing truck partnership.73 Similarly, the Bush administration’s
FreedomCAR and Fuel Research Program can be viewed as an incarnation of the PNGV
approach. In fact, one may debate the extent to which PNGV ended in 2002 or whether it
simply evolved into FreedomCAR, with a new name, charge, and organizational chart.
The goals of the Partnership and the federal participants shifted, to be sure, but the

72 Robert Chapman, “PNGV, A Model for Technology Partnerships?” AAAS Annual Meeting,
Petroleum Use in the Transportation Sector: Hearing Before the Subcommittee on Energy, Committee on
concept of the government working with the Big Three to achieve goals for alternative automotive technologies was the same.

According to the NRC, some of FreedomCAR’s strengths derive from its similarities to PNGV organizational structure and cooperative approach:

A major strength of the FreedomCAR and Fuel Partnership is that, like its predecessor, the Partnership for a New Generation of Vehicles (PNGV) program, it is organized around joint industry/government research teams. This structure brings the capabilities of the nation’s federal laboratories and other research institutions to bear on overcoming the problems, identified by industry, that are critical to achieving the program vision. This kind of cooperation is a very effective way to develop technologies that will satisfy all of the requirements for the deployment of radically new systems in the marketplace on a large scale.\(^\text{74}\)

This idea was echoed in the subsequent 2008 NRC review of FreedomCAR, noting how PNGV demonstrated the effectiveness of the organizational approach taken by FreedomCAR:

Management of the FreedomCAR and Fuel Partnership is a complex task because of the Partnership’s breadth, its technological sophistication, and its need for ongoing commitments from automobile companies and energy companies, as well as the federal government. The organization of the Partnership provides for the involvement of appropriate people to perform the needed tasks, all of the way from research scientists to those providing strategic direction. The earlier Partnership for a New Generation of Vehicles (PNGV) proved that this basic structure is effective.\(^\text{75}\)

Time will tell if the type of cooperation and organizational mechanisms used in PNGV will continue to be found in future federal initiatives. Even if they are, PNGV may not receive much credit as the source of the organizational mechanisms highlighted in this analysis, but the Partnership did appear to break new ground in making government-industry efforts more productive.

\(^{74}\) NRC, 2005, pp. 1-2.
\(^{75}\) NRC, 2008, p. 13.
One-time PNGV federal chairman Robert Chapman broadly pondered the applicability of the PNGV model:

Could PNGV be a model for ALL future government-industry technology programs? A model, yes, but not one that should be replicated exactly. If there is agreement between government and industry on the goals to be addressed, if multiple federal agencies are to be involved, if the industry may deal with the government in a reasonably coherent way, if there is strong administration and industry management support and if reasonable people approach the challenge of the partnership in a cooperative spirit, the chances of success based on the PNGV experience should be excellent.76

CHAPTER 12: A VEHICLE FOR CHANGE?

Posed with the challenge of motivating technology development and competitiveness in the domestic automotive industry, the Clinton administration responded with the Partnership for a New Generation of Vehicles, a policy approach centered on fostering a productive working environment between government and the Big Three domestic automakers. This dissertation finds that PNGV was successful in improving key relationships among participating stakeholders, especially between government and industry.

Regarding this relationship in particular, this dissertation finds a remarkably consistent story across years of articles, books, public announcements, stakeholder interviews, and personal observations. Many sources identified a persistently antagonistic relationship between government and industry in the decades prior to PNGV. Various sources characterized government-industry interactions as “almost unblemished adversarial interaction”\(^1\) and “a quarter century of head-butting hostility.”\(^2\) Most sources—including virtually all industry and government officials interviewed—noted improvements in the government-industry relationship during the 1990s, and none suggested that PNGV had a negative influence on this relationship. Sources making this assessment included analysts outside of the partnership as well as government participants. Of those, multiple sources, including most individuals interviewed for this dissertation, specifically attribute the positive changes in the relationship to PNGV.

While we can’t compare everything that happened during PNGV’s existence to what

\(^1\) Interview with government policy official C, 1999.
might have happened without it, it is clear that many observers and participants feel the Partnership was central to strengthening these government-industry relationships during its existence.

The dissertation also documents some of the mechanisms used in this cooperative approach, showing that working relationships improved at both technical and managerial levels. Within specific modes of government-industry interactions, most participants pointed to improvements in technical interactions in particular, largely among engineers and scientists facing common challenges. To a lesser extent, participants also viewed the industry interactions with the White House and with regulatory agencies improved, though it is difficult to separate out changes due to the partnership from changes due to other factors such as shifts in unrelated regulation.

The dissertation also finds specific ways in which the cooperation among the Big Three improved at the time of PNGV and USCAR – several industry participants and outside industry analysts noted improvements in communication, coordination, and cooperation among the Big Three. Attribution of these improvements to PNGV was less conclusive, however, as it was difficult to separate out the effects of PNGV from those of other interactions through USCAR and other consortia, or simply with the lifting of legal restrictions on industrial cooperation that happened during the 1980s.

The improvements in the relationships among industry stakeholders again were particularly apparent in the context of technical interactions. Industry participants noted in interviews that the engineers were comfortable interacting at a technical level to solve their common problems. However, some barriers to cooperation persisted among the

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2 Gruley and Gannon, 1993, p, 1D.
domestic automakers, including cultural differences, competitive tensions, and the ever-increasing multinational nature of the corporations involved (including, for example, the Daimler-Chrysler merger during PNGV’s existence).

After exploring the macro effects of the Partnership upon the relationships between government and industry and within industry, the dissertation focused in on how its specific components functioned. Reflecting the fact that any relationship is more than the sum of discrete interactions, the dissertation explored the partnership a dynamic process of interactions, having not only their intended outputs and outcomes but also feeding back to affect attitudes toward further interactions. This iterative process occurred constantly and at many different levels at once, so each interaction could have some bearing on the likelihood of future interactions and future successful outcomes of those interactions. While one might measure the value of the partnership by its progress and ultimate success in achieving technical goals, one could also see improvements in understanding, attitudes, interactions, and processes as important considerations in themselves, as they help enable the success of future interactions, even after the end of the partnership itself.

Finally, the dissertation sheds some light on the impact and influence of PNGV beyond its participants. PNGV may have had some positive side effects in its marketplace by sparking the interest of non-PNGV participants in developing and marketing alternative automotive technologies, which in turn may further have promoted domestic interest in these technologies. In assessing PNGV’s technical influence, it is impossible to say how much PNGV had to do with the current state of hybrid and fuel cell vehicles in the world. Clearly, one cannot say that PNGV was responsible for them
directly, especially since Toyota and Honda were the first to market their hybrid vehicles in the U.S. Instead PNGV’s effect on technological development may have had a greater role in setting an agenda than in investing in technology. Some analysts would go as far as to say that PNGV sparked a race among domestic and foreign OEMs to pursue these technologies.

While it remains unclear what prompted automakers around the world to compete increasingly in alternative technologies, what we can say is that over the years, many of the alternative technologies of interest to PNGV are now on the road, and words like “hybrid” have entered the public vocabulary. Without question, these technologies all have their roots in efforts that pre-date PNGV, and many of these vehicles have been sold by non-PNGV automakers, but it is also clear that at least some foreign efforts in this area increased after PNGV was created.

Another type of PNGV influence was external – the Partnership broke new ground in defining institutional arrangements that are possible between government and industry, demonstrating how new types of interactions can be productive. From the start, early Clinton administration PNGV announcements identified it as a new model for doing business. PNGV was certainly used during the Clinton administration as a guide for other government-industry partnerships, and the Bush administration’s FreedomCAR initiative maintained key elements of the PNGV model. Certainly PNGV provides an instructive case study for coordinating across multiple agencies, companies, and other organizations to identify and achieve common goals.

PNGV is unlikely to provide an integrated, off-the-shelf model, ready to be applied as-is in some other setting, but elements of the PNGV approach could be applied selectively. To that end, the dissertation explored the specific interactions and processes *within* the partnership, to help characterize whether, how, and how well specific components and processes of the partnership functioned. For example, Chapter 10 outlines the workings of PNGV through inter-participant communication, coordination, and organizational structures.

**Final Observations on PNGV and Government-Industry R&D Partnerships**

PNGV failed to achieve its primary technical goals. The Partnership did not produce the production prototypes, nor did it thrust the domestic auto industry into the lead in the market for new alternative vehicles. Given the turbulence that the domestic automotive industry faces in 2009, paired with Toyota’s continuing dominance of the market for hybrid vehicles, it is natural to wonder whether PNGV represents a missed opportunity. Perhaps the Big Three automakers missed a chance to get an early advantage in more efficient automotive technologies. Perhaps the government could have implemented the partnership in a more effective way. Despite these failures, this dissertation show how the cooperative approach PNGV used can be a useful model for building constructive relationships in a traditionally adversarial setting.

Highlighting this success despite the Partnership’s overall failure to meet its technical goals may bring to mind the old joke in which a doctor exclaims, “the operation was a success, but the patient died.” In the same way that such an operation cannot seriously be considered a success to the patient, the conclusions of this research would be inconsequential if they applied only in the context of the PNGV program itself. While
this dissertation devotes much discussion to the PNGV case, it does so to analyze and
chronicle why, how, and in what context this particular partnership was implemented. In
this way, the research is relevant more broadly to future government initiatives and
policies, especially those considering the use of government-industry R&D partnerships.

The following are four observations on PNGV’s implementation and history that
stood out during the course of the research for this dissertation. They may provide
lessons for future government-industry R&D partnerships. While these are drawn from
the work of others, each is supported by the original research conducted for this
dissertation, especially in the case of the fourth point.

In defining partnership goals, policy makers balance clarity, accountability, and
robustness.

Robert Chapman, the original chairman of the government’s PNGV Task Force
identified the value of “clear and simply stated goals” for PNGV, to help promote a
shared understanding by public and participants alike. For example, Mr. Chapman
indicated that “80 miles per gallon” was a goal everyone would understand.4

However, midway through the course of the partnership, the Goal 3 focus on
highly efficient mid-sized sedans had lost relevance as the automotive marketplace
evolved and consumer demands shifted to SUVs. These shifts suggest potential benefits
of goals that have some flexibility or robustness to withstand possible changes that affect

the partners and their motivations. Yet in defining goals for a partnership, permitting flexibility and robustness works against simple goals.

Meanwhile, some PNGV critics raised concerns for the lack of accountability built into the PNGV goals and design, noting there were no penalties if the industry did not meet the stated goals in the given time frame. Instead, PNGV was designed with a voluntary commitment to promote partnership in achieving challenging goals through uncertain means. In the end, trying to instill accountability further complicates both simple goals and program flexibility.

With hindsight, factors such as simplicity, accountability, and robustness are worth considering, but they are in conflict. Goals for R&D partnerships must find a balance across these and likely other considerations, depending on partnership priorities and dynamics of a particular implementation setting.

Other policy tools may be needed to complement the efforts of R&D partnerships despite any improvement in a government-industry relationship.

With the benefit of hindsight, we see how the specific technical goals of PNGV could not themselves take into account and overcome industry concerns for cost and consumer demand. Nor was PNGV accompanied by other policy instruments that might have addressed these concerns, such as regulations or tax policy. These could have included regulations or other policies that affected OEMs directly, or they might have affected consumer demand, such as tax incentives. Again, the Clinton administration

\[ \text{[5 For similar reasons, the PNGV partners intentionally avoided too many interim milestones to provide some schedule flexibility to permit progress amid uncertainty (Chapman, 1998, p. 42),}\]
\[ \text{[6 Chapman, 1998, p. 42.]} \]
consciously opted against them in PNGV’s design, but those implementing other R&D partnerships will face similar decisions and tradeoffs.

The PNGV example demonstrates that constructive relationships, while important, are not themselves enough to guarantee success and that other policy instruments may help.

Partnership developers and participants should keep in mind that each participating organization has distinct motivations that will guide its behavior.

In pondering the challenges the Big Three faced in moving from concept vehicle to production prototypes, their concerns for costs and uncertain demand for 80 mpg vehicles contributed to their reluctance to follow through. It is wise to consider partner motivations when setting up any partnership, but wiser still is to consider these motivations on an ongoing basis and communicate with partners regularly about internal and external pressures that affect their willingness and ability to move forward. As organizations work together, they gain greater understanding of similarities and differences in their motivations. Additionally, as an initiative progresses towards its goals, technical success and external factors such as market considerations will continue to affect their behavior.

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7 Various sources advocated for regulatory policies to accompany PNGV. See, for example, Sperling, 1994, p. 36.
Each partnering organization should encourage and enable staff communication and coordination, especially when working with nontraditional allies.

As an R&D partnership is developed, much of the communication and coordination is among government and industry executives. Much of the work of the partnership, however, will take place among technical staff that are not used to working together (and perhaps had not been permitted to work together in the past). The experiences of the PNGV technical teams suggest that cross-organizational teams need time to work together, develop trust and understanding, and to break down pre-existing prejudices.

The work of management thus should not be only to negotiate with other managers, but also enable staff coordination. Showing that communication, coordination, and cooperation are permitted and encouraged is a good start. If possible, motivating these behaviors is even better. If there are constraints on how cooperative staff should be, management should make those boundaries clear, or each staff member will define them his- or herself.

At a minimum, management should expect that relationships among staff (and at all levels) have to be built and strengthened over time.

PNGV failed to achieve its technical goals, but given the factors discussed above that may not be surprising. Ultimately, this study of PNGV provides a both promising and cautionary tale for implementing federal technology policies and partnerships. The hope of this author is that this dissertation will provide encouragement for future efforts
in pursuing collaborative approaches, as well as observations on specific aspects of a partnership to emulate or avoid.
APPENDIX A: GLOSSARY OF ABBREVIATIONS AND ACRONYMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAMA</td>
<td>American Automobile Manufacturers Association</td>
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<tr>
<td>ACC</td>
<td>Automotive Composites Consortium</td>
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<td>AMTEX</td>
<td>American Textile (Partnership)</td>
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<tr>
<td>ATP</td>
<td>Advanced Technology Program (agency within DOC)</td>
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<tr>
<td>Big Three</td>
<td>Ford, General Motors, and Chrysler (or DaimlerChrysler)</td>
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<tr>
<td>CAFE</td>
<td>Corporate average fuel economy (standards)</td>
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<td>CARB</td>
<td>California Air Resources Board</td>
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<td>CEA</td>
<td>Council of Economic Advisors (office of the Executive Office of the President)</td>
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<td>CNG</td>
<td>Compressed natural gas</td>
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<td>CO₂</td>
<td>Carbon dioxide</td>
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<td>CPBR</td>
<td>Consortium for Plant Biotechnology Research</td>
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<td>CRADA</td>
<td>Cooperative research and development agreement</td>
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<td>CRS</td>
<td>Congressional Research Service (department within the Library of Congress)</td>
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<td>DARPA</td>
<td>Defense Advanced Research Projects Agency (agency within DOD)</td>
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<tr>
<td>DOC</td>
<td>U.S. Department of Commerce</td>
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<td>DOD</td>
<td>U.S. Department of Defense</td>
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<td>DOE</td>
<td>U.S. Department of Energy</td>
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<td>DOI</td>
<td>U.S. Department of the Interior</td>
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<td>DOT</td>
<td>U.S. Department of Transportation</td>
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<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
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<tr>
<td>EPRI</td>
<td>Electric Power Research Institute</td>
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<tr>
<td>EUCAR</td>
<td>European Council for Automotive R&amp;D</td>
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<tr>
<td>EV</td>
<td>Electric vehicle</td>
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<tr>
<td>FreedomCAR</td>
<td>Freedom Cooperative Automotive Research (federal initiative)</td>
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<tr>
<td>GDP</td>
<td>Gross domestic product</td>
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<tr>
<td>GM or G.M.</td>
<td>General Motors</td>
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<tr>
<td>HEV</td>
<td>Hybrid-electric vehicle</td>
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<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>ICE</td>
<td>Internal combustion engine</td>
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<tr>
<td>ICEL</td>
<td>International Cooperative for Environmental Leadership</td>
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<td>ICOLP</td>
<td>International Cooperative for Ozone Layer Protection</td>
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<td>IVI</td>
<td>Intelligent Vehicle Initiative</td>
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<td>LEV</td>
<td>Low emission vehicle</td>
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<td>MEP</td>
<td>Manufacturing Extension Partnership (program within DOC)</td>
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<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<tr>
<td>MPG or mpg</td>
<td>Miles per gallon</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<tr>
<td>NCAICM</td>
<td>National Center for Advanced Information Components Manufacturing</td>
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<tr>
<td>NEC</td>
<td>National Economic Council (office of the Executive Office of the President)</td>
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<td>NHTSA</td>
<td>National Highway Traffic Safety Administration (agency within DOT)</td>
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<td>NIST</td>
<td>National Institute of Standards and Technology (agency within DOC)</td>
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<td>NOx</td>
<td>Nitrogen oxide</td>
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<tr>
<td>NRC</td>
<td>National Research Council (the working arm of the National Academies)</td>
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<tr>
<td>NSF</td>
<td>National Science Foundation</td>
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<tr>
<td>NSTC</td>
<td>National Science and Technology Council (coordinating body for science and technology policy across federal agencies, administered by OSTP)</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
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<tr>
<td>OEM</td>
<td>Original equipment manufacturer</td>
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<tr>
<td>OMB</td>
<td>Office of Management and Budget (office of the Executive Office of the President)</td>
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<tr>
<td>OSTP</td>
<td>Office of Science and Technology Policy (office of the Executive Office of the President)</td>
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<tr>
<td>OTA</td>
<td>Office of Technology Assessment (office of the U.S. Congress)</td>
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<td>PATH</td>
<td>Partnership for Advancing Technology in Housing</td>
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<td>PCAST</td>
<td>President’s Committee of Advisors on Science and Technology (external committee advising the President on science and technology policy, administered by OSTP)</td>
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<tr>
<td>PNGV</td>
<td>Partnership for a New Generation of Vehicles</td>
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<td>PRF</td>
<td>Plastics Recycling Foundation</td>
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<tr>
<td>RaDiUS</td>
<td>Research and Development in the United States (a RAND database)</td>
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<tr>
<td>RAND</td>
<td>The RAND Corporation</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>R&amp;D</td>
<td>Research and development</td>
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<tr>
<td>RTDF</td>
<td>Remediation Technologies Development Forum</td>
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<tr>
<td>SAE</td>
<td>Society for Automotive Engineering</td>
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<tr>
<td>SBIR</td>
<td>Small Business Innovation Research</td>
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<tr>
<td>SEMATECH</td>
<td>Semiconductor Manufacturing Technology (consortium)</td>
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<tr>
<td>SMPC</td>
<td>Specialty Metals Processing Consortium</td>
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<tr>
<td>UAW</td>
<td>United Auto Workers (union)</td>
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<tr>
<td>ULEV</td>
<td>Ultra-low emission vehicle</td>
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<tr>
<td>USABC</td>
<td>United States Advanced Battery Consortium</td>
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<tr>
<td>USCAR</td>
<td>United States Council for Automotive Research (R&amp;D coordination body for the Big Three automakers)</td>
</tr>
<tr>
<td>USDA</td>
<td>U.S. Department of Agriculture</td>
</tr>
<tr>
<td>USDC</td>
<td>United States Display Consortium</td>
</tr>
<tr>
<td>USTR</td>
<td>U.S. Trade Representative (office of the Executive Office of the President)</td>
</tr>
<tr>
<td>ZEV</td>
<td>Zero emission(s) vehicle</td>
</tr>
</tbody>
</table>
Letter from PNGV Secretariat Encouraging Participant Cooperation with Research Interviews

November 26, 1999

To Whom It May Concern:

I encourage your cooperation with Dave Trinkle’s research on PNGV, as I believe it will be beneficial to the program. As a companion to Robert Chapman’s book The Machine That Could, PNGV, A Government-Industry Partnership, this study will yield insights that should be of use to the continuing management of this and follow-on cooperative efforts in the automotive industry. Furthermore, to the extent that PNGV is being used as a model for government-industry coordination, the documentation of its processes and accomplishments should be of benefit to other potential partnerships.

While I encourage your cooperation, your participation in this effort is strictly voluntary, and how you respond to interview questions is at your discretion.

If you have questions or concerns regarding this study, you may contact me directly at 202-482-6268.

Sincerely,

[Signed]

John Sargent
Director
PNGV Secretariat
Participant Interview Protocol

PURPOSE
I am conducting a study on PNGV for the Science and Technology Policy Institute, at the RAND Corporation. This research is also my doctoral thesis for the RAND Graduate School of Policy Studies. This study was funded in part by the PNGV Secretariat at the U.S. Department of Commerce.

By talking to a number of participants that have different roles at various levels of the Partnership, we hope to build a better picture of how PNGV works and get a better feel for its accomplishments. We hope that these results will useful to those planning and managing other types of partnerships. We would like to list the names of participants in the study, but we will honor requests to remain unidentified.

This interview takes about an hour. You may decline to answer any questions, and you may discontinue the interview at any time.

I will ask a series of questions having to do with:

- you and your role in the Partnership
- your perspectives on how PNGV works, and
- your perceptions of what PNGV has accomplished.

Date:  
Time:  
ID#:  

A. IDENTITY AND ROLE

Interviewee:
Title:
Affiliation:

A1) How long have you worked for [employer]?
A2) What is [employer]'s role in PNGV?
A3) What do you do for PNGV?  
   (title? different from job for [employer]?)
A4) How long have you participated in that way?
A5) What % of job is spent on PNGV-related work?
A6) Have you had other roles in PNGV?

Now I'm going to ask some questions on how PNGV works...

B. PROCESSES

B1) In what PNGV [groups] do you participate?
B2) Explain the role of your [group] within PNGV?
B3) How do they interact? (meetings? tech interaction? phone?) How often? (where?)
B4) What is the purpose of these interactions?
B5) Have these interactions changed over time? How?
B6) Does your [group] interact with other parts of PNGV? With which groups? How? How frequently?
B7) Did [group] exist prior to PNGV?
B8) Would this effort be going on without PNGV?
B9) Describe the contribution of the various components of the [group]. (esp. contrast IND and GOV)
B10) How would you describe the attitudes of these components towards each other? (early and late)
B11) How would you describe the interactions of [group] members from different companies towards each other?
B12) Have you learned any practical lessons in how to or how not to organize a [group] in a partnership like this?
B13) Have you observed anything in the partnership as a whole (outside your team) that might be a practical lesson in how to or how not to conduct a partnership like this?
B14) How effectively would you say the partnership as a whole is run
B15) In 2004, at the scheduled completion of PNGV, will your team remain intact?
B16) If so, how will the end of the Partnership change its function?

C) CREATION OF THE PARTNERSHIP

C1) Insights?

Now I'm going to ask some questions about your perspectives on what your [group] --and PNGV in general-- has accomplished…

D. ACCOMPLISHMENTS

[Tech. Participants only]
D1) Has your [group] made or contributed to what you'd consider to be "breakthrough" advances in your area?
D2) Which of the following statements is most accurate [per advance]:
   a) This would not have happened without PNGV.
   b) This would not have happened as quickly without PNGV.
   b) This would not have happened as well without PNGV.
   c) PNGV itself had little to do with this breakthrough
   d) (Other)
D3) How does your [group] measure its progress/accomplishments?
D4) Who came up with these metrics?
D5) Do you find them to be a meaningful measure of progress/acc's?
D6) How is your [group] doing relative to these metrics? a) effectiveness b) timeliness
D7) Has your group been measured by any other, external metrics?
D8) (D6 again)

[All Participants]
D9) Have there been any factors in particular that have made the partnership more successful?
D10) Have there been any barriers to the partnership?
D11) What is your perception of the accomplishments of the PNGV effort as a whole?
D12) How well do you perceive PNGV to be doing in accomplishing its primary goals? (Revisit D2)
D13) Can you think of any major impact PNGV has made outside of its explicit goals? (Revisit D2)
D14) Have you noticed any differences in attitudes between the companies? Personal level? In more general sense?
D15) Have you noticed any differences in attitudes between government and industry? Personal level? In more general sense?
D16) From your coworkers that do not participate in PNGV, have you heard any positive views expressed towards the partnership? Negative views?
D17) Has your management expressed any particularly positive views? Negative views? Any opponents?
APPENDIX C: SUPPORTING DATA ON AUTOMOTIVE NEWS “OPINION” ANALYSIS

Below are the codes assigned to Automotive News “Opinion” columns presented in Figures 7-1, 10-7, and 10-8. The assessment started with the first issue from January 1992. Every week was assessed through mid 2002, but Table C-1 includes only those weeks that included some pertinent opinion. Note that scores were assigned based on entire week’s column, and not just the excerpts shown below. All excerpts are quotes except when summarized parenthetically.

Key: A score of “1” indicates a positive opinion regarding the column in question, a “-1” a negative opinion, and a “0” a neutral, mixed, or ambiguous opinion.

Table C-1: Codes Assigned to Automotive News “Opinion” Columns

<table>
<thead>
<tr>
<th>Date</th>
<th>Regs</th>
<th>PNGV</th>
<th>Admin.</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/15/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>I am not sure just how far the U.S. government will let this cooperation go...</td>
</tr>
<tr>
<td>6/22/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>…we have long argued...that a large gasoline tax hike is a better way to achieve fuel efficiency than laws setting up a complicated bureaucracy of targets, measurement and year-to-year credits.</td>
</tr>
<tr>
<td>7/27/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>…we’d like the candidates to get very specific about how they want that industry [auto] to look four years from now.</td>
</tr>
<tr>
<td>8/10/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Will you [Mr. Bush and Mr. Clinton] tell all those federal agencies that the car dealer is not the enemy, so kindly get off his back?</td>
</tr>
<tr>
<td>9/7/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Around the country, candidates don’t seem anxious to confront an auto industry...</td>
</tr>
<tr>
<td>9/28/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>A higher CAFE law is crude legislative shoving at the marketplace. A higher gasoline tax is a gentle, low-overhead way to get the same effect by letting people want fuel efficiency. ... Yes, it would take political courage.</td>
</tr>
<tr>
<td>10/12/92</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Industry escapes ‘October surprise’ from Congress</td>
</tr>
<tr>
<td>10/26/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Washington must...begin to forge the type of cooperative government-business relationship that enhances growth rather than stifles it.</td>
</tr>
<tr>
<td>11/9/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>The federal government must coordinate its approaches to the problems of the auto industry... Bill Clinton can preside over growth and improvement. Let’s find a way to increase fuel economy without harming the industry and its jobs.</td>
</tr>
<tr>
<td>11/16/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>The industry’s relationship with Washington is going to change, and that change could be quite dramatic.</td>
</tr>
<tr>
<td>11/23/92</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>[Bill Clinton should] raise taxes on carbon-based fuel to encourage marketplace control of fuel economy...</td>
</tr>
<tr>
<td>12/14/92</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>There is some speculation in Detroit that the Big 3 might have an opportunity to jointly develop an electric vehicle... Cooperation makes sense for the future. The government will have to change some laws to get the job done.</td>
</tr>
</tbody>
</table>
Table C-1: Codes Assigned to *Automotive News* “Opinion” Columns

<table>
<thead>
<tr>
<th>Date</th>
<th>Regs</th>
<th>PNGV</th>
<th>Admin.</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4/93</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>(Wondering about new administration.)</td>
</tr>
<tr>
<td>1/18/93</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>...the Big 3 are demonstrating a new-found congeniality that I have never seen before. Not only are they starting to talk about cooperation, but they seem to be doing something about it at the same time... It is increasingly clear the new Clinton administration will be a far better listener than the previous administration...</td>
</tr>
<tr>
<td>1/25/93</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>There is a high level of optimism in the automobile industry these days.... Today, it remains a mystery how this administration is going to tackle the multitude of issues that confront this industry.</td>
</tr>
<tr>
<td>3/1/93</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>[Regardless of what you thought about the Reagan-Bush years, [a friend] said, here was a gradual slowdown in regulation from Washington. Under Clinton, activity is going to crank up dramatically, ... [which will] add to the cost of a new automobile.</td>
</tr>
<tr>
<td>3/29/93</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>The Clinton administration still thinks 40 mpg is the right goal.... How do you do that if not through CAFE?</td>
</tr>
<tr>
<td>5/10/93</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>(Against NHTSA tests on gas tanks of GM pickups, citing lack of leadership.)</td>
</tr>
<tr>
<td>5/17/93</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>We have come a very long way in the last 25 years [of government involvement].... And it was done in a confrontational atmosphere, which made it more difficult.... Wouldn't it be wonderful to see what we can do if everybody cooperates during the next 25 years?</td>
</tr>
<tr>
<td>6/28/93</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Word in Detroit is that this administration is now unified.</td>
</tr>
<tr>
<td>7/19/93</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>(Concern for lack of Clean Air officials at EPA, NHTSA.) Industry and consumers deserve better.</td>
</tr>
<tr>
<td>10/4/93</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Some exciting news came out of Washington last week. Who would have believed that the U.S. government and the Big 3 would actually get together on a cooperative project?... The government and the Big 3 plan to develop an appealing vehicle that will have phenomenal fuel economy... without really big government help, you couldn't market such a car competitively.</td>
</tr>
<tr>
<td>10/18/93</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>The Big 3 and the federal government have been at each other's throats for a generation. Will they really be able to cooperate on anything?... Will the whole program be shoved to the back burner after the initial enthusiasm cools down?...</td>
</tr>
<tr>
<td>11/8/93</td>
<td>1</td>
<td></td>
<td></td>
<td>President Bill Clinton is courageously trying to persuade fearful members of his own party to do what's right (regarding NAFTA).</td>
</tr>
<tr>
<td>12/13/93</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>...the Big 3 are talking about common problems for the first time. And they are even talking to Washington in a mutual spirit that things can be done for the economic good of the industry and the nation. And it appears that the government agrees for the first time.</td>
</tr>
<tr>
<td>12/20/93</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>We have a level of government-industry cooperation that has never been seen before. Whether this love affair will last is iffy. But while it lasts, it is something to behold.</td>
</tr>
<tr>
<td>12/27/93</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1993 was a very good year.... Bill Clinton, who actually does envision the government working together with the industry to solve societal problems. And who, with nothing to gain and plenty to lose for himself, made NAFTA happen.</td>
</tr>
</tbody>
</table>
Table C-1: Codes Assigned to *Automotive News* “Opinion” Columns

<table>
<thead>
<tr>
<th>Date</th>
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<th>PNGV</th>
<th>Admin.</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/17/94</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>President Clinton remarkably has remained a great friend of the Big 3... The White House now talks to the Big 3--and does something about what it hears... The super car project...could be this administration's greatest automotive legacy. Instead of a hike in fuel-economy standards, the government and industry became partners...</td>
</tr>
<tr>
<td>2/28/94</td>
<td>0</td>
<td></td>
<td></td>
<td>(Concern for trade war with Japan.)</td>
</tr>
<tr>
<td>5/16/94</td>
<td>1</td>
<td></td>
<td></td>
<td>Give cheers to Presidents George Bush and Bill Clinton. NAFTA delivers as promised.</td>
</tr>
<tr>
<td>5/30/94</td>
<td>0</td>
<td>0</td>
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<td>Big three executives believe Clinton may be preparing to renege on his deal to prevent an increase in corporate average fuel economy in exchange for the industry's cooperation in the clean-car initiative... A Clinton double-cross would be disastrous for improved industry-government relations.</td>
</tr>
<tr>
<td>8/8/94</td>
<td>0</td>
<td></td>
<td>0</td>
<td>Clinton administration must avoid the easy, political path [regarding CAFE]; it must not make the auto industry carry the entire clean-air burden.</td>
</tr>
<tr>
<td>9/5/94</td>
<td>0</td>
<td></td>
<td>0</td>
<td>It's been known as the Supercar program ever since it was hatched. Why change it?</td>
</tr>
<tr>
<td>10/24/94</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Concern for DOT focus on GM pickup safety.)</td>
</tr>
<tr>
<td>10/31/94</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Unfortunately, the clean-car project of the Big 3 and the Clinton administration may start to look more like the superconducting supercollider--a big hole in the ground where taxpayers' money is dumped. A 10-year plan is all the automakers and the government have to show for a year's work... A message to both the Big 3 and the administration: If you expect U.S. taxpayers to shell out year after year, you'll have to show something a lot more tangible--and soon.</td>
</tr>
<tr>
<td>11/14/94</td>
<td>0</td>
<td></td>
<td></td>
<td>(Concern over split government)</td>
</tr>
<tr>
<td>11/21/94</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>The GOP sweep may imperil the Partnership for a New Generation of Vehicles... It's a Democratic program, and all Democratic programs are in jeopardy. Much of the money comes from Congress, and the new keepers of the coffers will demand tangible results, and soon.; [regarding GM pickups] A White House spokesperson said the president is not likely to get involved in regulatory matters. Wrong! That's exactly what the president must do.</td>
</tr>
<tr>
<td>11/28/94</td>
<td>-1</td>
<td></td>
<td></td>
<td>Does the government have the right to change the standards for a vehicle long after it has been engineered and sold? (Regarding 20 year old GM pickups)</td>
</tr>
<tr>
<td>1/2/95</td>
<td>0</td>
<td></td>
<td></td>
<td>...the auto industry desperately needs federal regulation... Government is still going to be a challenge for the automobile industry [in 1995], as it has been for decades.</td>
</tr>
<tr>
<td>2/6/95</td>
<td>1</td>
<td></td>
<td></td>
<td>... Give no credit, though, to the selfish and cowardly members of our new U.S. Congress who left it up to President Clinton to help Mexico [and the U.S.] through Mexico's liquidity crisis.</td>
</tr>
<tr>
<td>2/20/95</td>
<td>0</td>
<td></td>
<td></td>
<td>While the new Congress tries to root out pointless government regulations, it ought to spend a few minutes on the American...</td>
</tr>
</tbody>
</table>
Table C-1: Codes Assigned to *Automotive News* “Opinion” Columns

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<th>PNGV</th>
<th>Admin.</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/27/95</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>Automobile Labeling Act. ...The act was a barefaced favor to the Big 3.</td>
</tr>
<tr>
<td>4/17/95</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>It was appropriate that the ITS America conference was held in Washington; intelligent transportation systems offer a bright promise of technology, along with the usual opportunities for budgetary and regulatory excess</td>
</tr>
<tr>
<td>5/22/95</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>Memo to the U.S. Congress: Give the Supercar project the money your predecessors have promised it. It's a worthwhile program, but it needs government-industry funding and government-industry expertise.</td>
</tr>
<tr>
<td>6/19/95</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>The stiff trade sanctions imposed against Japanese luxury models last week by the White House are inappropriate and will be ineffective.</td>
</tr>
<tr>
<td>6/19/95</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>As the battle over electric vehicles has shown, the success of the government-industry partnership to create a mid-sized car that gets 80 mpg hinges on consumer acceptance as well as technological breakthroughs... Still, automakers must balance the demands of the environment and the economy.</td>
</tr>
<tr>
<td>7/3/95</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>The Justice Department’s ill-advised investigation of auto pricing is winding down. It is an inquiry that served no purpose and never should have happened.... It’s time that much of the regulation and legislation that is now done at the federal level be returned to the 50 states.</td>
</tr>
<tr>
<td>8/28/95</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>For the first time, the National Highway Traffic Safety Administration has issued an identical standard (head impact) for cars and light trucks. We hope that this is the first step toward ending the current senseless distinction between the two types of passenger-carrying vehicles.</td>
</tr>
<tr>
<td>9/4/95</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>The goals of the PNGV should be considered a national priority. To achieve them, the biggest breakthrough would be a commitment to long-term thinking and planning on Capitol Hill.</td>
</tr>
<tr>
<td>11/13/95</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Society, through its government, has a right to minimize fuel consumption, both for environmental reasons and for national security. CAFE had some success there, although it also encouraged people to drive more miles in their more fuel-efficient vehicles. A better solution would be large increases in fuel taxes.</td>
</tr>
<tr>
<td>1/22/96</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>(Criticism of Supreme Court ruling that Ford could be taken to court for selling 88 car w/o airbags, despite lack of standard)</td>
</tr>
<tr>
<td>3/18/96</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Although those numbers [of deaths caused by airbags] are small when compared with the number of lives airbags have saved, Congress is right to be concerned.</td>
</tr>
<tr>
<td>5/13/96</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Congress should look at all its regulations on the industry together, not just one at a time. ... That's why the current political fuss about a small temporary hike in gasoline prices is so irresponsible. ...The challenge for Congress is to understand that when it legislates for one part of the industry, it affects other parts--sometimes leading to death and injury.</td>
</tr>
<tr>
<td>Date</td>
<td>Regs</td>
<td>PNGV</td>
<td>Admin.</td>
<td>Excerpts</td>
</tr>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6/24/96</td>
<td>-1</td>
<td></td>
<td></td>
<td>Federal vehicle-safety regulations are one of the best arguments for government regulation...But safety regulations are hard to make. ...NHTSA has fallen into the habit of regulating by anecdote...Now NHTSA wants to expand regulation by implication [with tests based on random sampling of vehicles].</td>
</tr>
<tr>
<td>8/26/96</td>
<td>-1</td>
<td></td>
<td></td>
<td>NHTSA can do more by regulating higher safety standards than by overdoing recalls of old vehicles... The way to speed safety innovation is to make standards tougher and then to allow those standards to protect well-meaning automakers who adopt the new technology.</td>
</tr>
<tr>
<td>9/9/96</td>
<td>1</td>
<td></td>
<td></td>
<td>Not all of NHTSA's standards, directives and actions have been praiseworthy... But the auto industry and the nation are better off with NHTSA than they would be without it. ...We salute NHTSA for 30 years of service to the industry and to America.</td>
</tr>
<tr>
<td>9/23/96</td>
<td>0</td>
<td></td>
<td></td>
<td>[The relationship between Congress and the U.S. auto industry] has changed for the better, thanks to a little common sense and a little patience.</td>
</tr>
<tr>
<td>9/30/96</td>
<td>1</td>
<td></td>
<td></td>
<td>(Praises revision of federal regulation regarding vehicle leasing)</td>
</tr>
<tr>
<td>11/11/96</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>The industry works well with Bill Clinton. He supported NAFTA and the Supercar project, and he hasn't tried to upset the automotive apple cart.</td>
</tr>
<tr>
<td>11/25/96</td>
<td>-1</td>
<td></td>
<td></td>
<td>The National Highway Traffic Safety Administration has taken too long to act on airbag safety.</td>
</tr>
<tr>
<td>12/2/96</td>
<td>-1</td>
<td></td>
<td></td>
<td>Through rigidity and incompetence, federal regulators have managed to undermine the airbag.</td>
</tr>
<tr>
<td>12/30/96</td>
<td>-1</td>
<td></td>
<td></td>
<td>(NHTSA should allow switches on airbags)</td>
</tr>
<tr>
<td>1/6/97</td>
<td>-1</td>
<td></td>
<td></td>
<td>(NHTSA finally issued airbag switch standards)</td>
</tr>
<tr>
<td>2/24/97</td>
<td>0</td>
<td></td>
<td></td>
<td>(Government should decide what's permissible regarding airbags.)</td>
</tr>
<tr>
<td>3/24/97</td>
<td>-1</td>
<td></td>
<td></td>
<td>(NHTSA waited too long again to OK slower airbags)</td>
</tr>
<tr>
<td>4/14/97</td>
<td>1</td>
<td></td>
<td></td>
<td>The Partnership for a New Generation of Vehicles is a worthy endeavor. It has identified technologies that could multiply the efficiency of vehicles... But the partnership is constantly threatened by a Congress that wants to cut spending, the environment be damned.... As long as fuel remains dirt-cheap, high-efficiency vehicles (and PNGV) will be irrelevant to Americans tastes.</td>
</tr>
<tr>
<td>5/5/97</td>
<td>-1</td>
<td></td>
<td></td>
<td>(NHTSA too long to adopt std)</td>
</tr>
<tr>
<td>5/26/97</td>
<td>1</td>
<td></td>
<td></td>
<td>NHTSA to develop roll tests (good -- don't dither)</td>
</tr>
<tr>
<td>6/30/97</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>A lot of folks at the EPA are chomping at the bit to raise the bar, and ...our industry is probably at the top of the list, considering Vice President Al Gore’s public disdain for the auto and for this industry. ... The automobile industry has eliminated most of the exhaust emissions. Let's hope the powers that be understand that the rest of the job must be considered in a reasonable manner.</td>
</tr>
<tr>
<td>7/7/97</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Clinton administration dragging feet on global warming treaty -- big 3 should step up)</td>
</tr>
<tr>
<td>8/4/97</td>
<td>1</td>
<td>1</td>
<td></td>
<td>...battling over the PNGV budget has become an annual affair, with lawmakers railing against &quot;corporate welfare&quot; and trying to tighten</td>
</tr>
</tbody>
</table>
Table C-1: Codes Assigned to *Automotive News* “Opinion” Columns

<table>
<thead>
<tr>
<th>Date</th>
<th>Regs</th>
<th>PNGV</th>
<th>Admin.</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/6/97</td>
<td>0</td>
<td></td>
<td></td>
<td>PNGV's belt... Cutting PNGV funds would be a mistake:...By keeping the money flowing the government maintains some leverage in keeping the Big 3 focused on future fuel economy and emissions improvements... The PNGV partnership has been successful—a rarity in government-private industry joint ventures.</td>
</tr>
<tr>
<td>10/27/97</td>
<td>1</td>
<td></td>
<td>1</td>
<td>Clearly, Toyota got to the road first with a promising piece of technology. But a key component of the PNGV program is affordability. None of the Big 3 want to eat the losses Toyota has with the Prius. That's why there isn't a Ford, Chrysler or GM hybrid on the road today. Eating those losses may be the price of leadership.</td>
</tr>
<tr>
<td>11/17/97</td>
<td>-1</td>
<td>-1</td>
<td></td>
<td>(A proposal for limited airbag deactivation sits at OMB/White House)</td>
</tr>
<tr>
<td>11/24/97</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>(Finally OMB/White House act on bag switch)</td>
</tr>
<tr>
<td>12/22/97</td>
<td>1</td>
<td></td>
<td>1</td>
<td>(Praises CARB plan on light truck loopholes—provided lead time)</td>
</tr>
<tr>
<td>1/5/98</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Face it. The Clinton Administration gave the American auto industry a reprieve. Instead of increasing traditional fuel-economy standards, the government became partners with the Big 3 in a scramble for what seemed like a myth: the 80-mpg family sedan. And darned if it's not working. ...For five years, the PNGV has been taking federal money. The Big 3 is now showing concrete evidence that the funding is paying off.</td>
</tr>
<tr>
<td>1/12/98</td>
<td>1</td>
<td></td>
<td>1</td>
<td>Each of the Big 3 is ready to make good the promises made with their Partnership for a New Generation of Vehicles It's not hype.</td>
</tr>
<tr>
<td>1/26/98</td>
<td>1</td>
<td></td>
<td>1</td>
<td>(Praises NHTSA's airbag solution allowing some owners to get shut-off switches)</td>
</tr>
<tr>
<td>3/16/98</td>
<td>1</td>
<td></td>
<td></td>
<td>The steel industry has advanced the Supercar project as well as its own interests...It shows continued progress in the spirit of the Big 3/government Partnership for a New Generation of Vehicles....The PNGV has helped drive innovation in a field in which innovation was not really expected.</td>
</tr>
<tr>
<td>4/6/98</td>
<td>0</td>
<td></td>
<td></td>
<td>The House Commerce Committee is studying changes in the American Automobile Labeling Act. We say: Don't alter it; kill it.</td>
</tr>
<tr>
<td>4/13/98</td>
<td>0</td>
<td></td>
<td></td>
<td>If we must have corporate average fuel economy standards, the N.H.T.S.A. should enforce them. But first, it might be wise for Congress to tell NHTSA just what enforcement means.</td>
</tr>
<tr>
<td>4/20/98</td>
<td>1</td>
<td></td>
<td></td>
<td>Some situations in the auto industry scream for regulation. The rollover tendencies of sport-utilities are in that category. ...So, the warning labels are a good start, NHTSA. They're only a start.</td>
</tr>
<tr>
<td>5/11/98</td>
<td>-1</td>
<td></td>
<td></td>
<td>...GM is the victim of a goofy CAFE law that builds in its own exceptions and encourages—almost demands—the sort of games GM is playing. It's time for Congress to revisit that law.</td>
</tr>
<tr>
<td>5/25/98</td>
<td>1</td>
<td></td>
<td></td>
<td>There is a place for federal jurisdiction. And highway safety is one area in which the feds should get involved because it affects all of us. They should start with drunken driving.</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>6/15/98</td>
<td>-1</td>
<td></td>
<td></td>
<td>(NHTSA issue on truck/car collisions) Other than the unintended consequences of CAFE, there's no bad guy here.</td>
</tr>
<tr>
<td>8/24/98</td>
<td>1</td>
<td></td>
<td></td>
<td>(Likes federal appeals decision that Clean Air Act allows standards for CA and US but not NY.)</td>
</tr>
<tr>
<td>9/28/98</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Dislikes NHTSA rule to test bags on unbelted dummies, requiring stronger bags, which are more dangerous)</td>
</tr>
<tr>
<td>10/19/98</td>
<td>0</td>
<td>1</td>
<td></td>
<td>Automakers and others involved in the Partnership for a New Generation of Vehicles are looking at every manner of powerplant, and one technology's &quot;lost souls&quot; may have gained new stature this month.... [Diesel] deserves another chance and a new image.</td>
</tr>
<tr>
<td>11/9/98</td>
<td>0</td>
<td></td>
<td></td>
<td>... [IRS] has issued a ruling that makes sense. The IRS decided that cash incentives paid by auto manufacturers to dealership salespeople are not wages...</td>
</tr>
<tr>
<td>12/7/98</td>
<td>-1</td>
<td></td>
<td></td>
<td>It's long past time for [NHTSA] to get serious about the test standards for new, smart airbags.</td>
</tr>
<tr>
<td>12/28/98</td>
<td>-1</td>
<td></td>
<td>0</td>
<td>(Suggested resolutions) &quot;Bill Clinton: I might just quit and turn this job over to Al Gore, and then won't you guys in Detroit wish you'd been more supportive of your president? .... [In 1999] Washington will take an even bigger role in safety and emissions of cars and particularly light trucks. Unfortunately there won't be any voice in Washington to counter the claims of the regulators.</td>
</tr>
<tr>
<td>1/25/99</td>
<td>0</td>
<td></td>
<td></td>
<td>The auto and oil industries are locking horns again about the sulfur content in gasoline, and it is time for the federal EPA to step in and make the oil refiners toe the mark.</td>
</tr>
<tr>
<td>2/1/99</td>
<td>-1</td>
<td></td>
<td></td>
<td>The knee-jerk ill will that some in Congress and the White House harbor for dealers is hurting consumers.</td>
</tr>
<tr>
<td>3/8/99</td>
<td>-1</td>
<td></td>
<td></td>
<td>Cars and trucks are incomparably safer today than they were 30 years ago. Yet they're not safe enough.... Here's the interaction: Partly because gasoline is so cheap, Americans don't care about fuel economy when they buy. So Americans migrate to sport-utilities, pickups and minivans. But because of CAFE, automakers also must sell lots of feather-light cars and small pickups. (Some praise, but advocates harmonizing regulations)</td>
</tr>
<tr>
<td>4/26/99</td>
<td>1</td>
<td></td>
<td></td>
<td>The auto industry has finally wised up in Washington. Instead of publicly resisting tougher clean-air rules, the companies are cooperating with the EPA. That's the right approach. Auto companies cannot afford to paint themselves as anti-clean air. ...</td>
</tr>
<tr>
<td>5/17/99</td>
<td>1</td>
<td></td>
<td></td>
<td>The EPA's Tier 2 pollution regulations are coming, and the auto industry will have to learn to live with them, like 'em or not. The rewards for meeting the new standards will be significant. The penalties for those who drag their feet will be equally significant.</td>
</tr>
<tr>
<td>6/7/99</td>
<td>-1</td>
<td></td>
<td></td>
<td>The N.H.T.S.A. continues to wrestle with the rollover problem...it's time to quit dithering and make a decision.</td>
</tr>
<tr>
<td>6/14/99</td>
<td>-1</td>
<td>0</td>
<td></td>
<td>...But it's past time to urge the government to make a real energy policy, and not some command-and-control fig leaf.... The Clinton administration agreed not to push CAFE if the Big 3 created the Partnership for a New Generation of Vehicles, the search for the 80-mpg Taurus...[The Senate] should show some courage and urge...</td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>11/1/99</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Re: NHTSA proposal for new side impact standards) When regulators...insist on creating proprietary standards when perfectly good rules already are in effect elsewhere, they are guilty of the same boneheaded thinking that plagued automakers for decades: The not-invented-here syndrome.</td>
</tr>
<tr>
<td>1/3/00</td>
<td>0</td>
<td></td>
<td></td>
<td>The EPA's Tier 2 clean-air rules show that petroleum refiners--among others--still carry bigger sticks in Washington than do automakers... The auto industry must do its part on environmental, safety and social issues, but others must be held accountable too.</td>
</tr>
<tr>
<td>2/7/00</td>
<td>0</td>
<td></td>
<td></td>
<td>If the industry doesn't develop a responsible position [for on-board electronic devices], with which all automakers comply, you can be the government will impose something worse.</td>
</tr>
<tr>
<td>2/28/00</td>
<td>0</td>
<td></td>
<td>-1</td>
<td>It has been a mistake for the White House to dilly-dally in adopting the new-airbag rules that ...could have been in place months ago.... This may be an election year, but it's time for the lame duck Clinton administration to stop playing politics with the lives of women and children.</td>
</tr>
<tr>
<td>3/13/00</td>
<td>0</td>
<td></td>
<td></td>
<td>The days when the government had to prod lethargic automakers to make safer vehicles are long gone. Now, the government can't write regulations fast enough to keep up with advances in safety technology.... There are safety issues with hydrogen-powered vehicles, but at least the laws of physics and economics seem to agree....</td>
</tr>
<tr>
<td>4/24/00</td>
<td>1</td>
<td></td>
<td></td>
<td>A dramatic increase [in CAFE] would damage the industry, but a moderate increase in conjunction with some of the industry’s proposals could be the best of all worlds.</td>
</tr>
<tr>
<td>5/15/00</td>
<td>1</td>
<td></td>
<td></td>
<td>The government did the right thing about dummies and morons (regarding DOT decision on airbag tests).</td>
</tr>
<tr>
<td>5/22/00</td>
<td>1</td>
<td></td>
<td></td>
<td>[NHTSA’s] decision to reject a new investigation of so-called sudden acceleration shows uncommon backbone for a government bureaucracy.</td>
</tr>
<tr>
<td>5/29/00</td>
<td>0</td>
<td>1</td>
<td></td>
<td>(Discusses low-sulfur needs for PNGV’s diesel solutions for PNGV and concern for oil industry resistance.) ...the Clinton-Gore administration should hang tough on this one.</td>
</tr>
<tr>
<td>6/5/00</td>
<td>-1</td>
<td></td>
<td></td>
<td>Rather than striking a balance among automakers and consumer groups on car/truck rollovers, [NHTSA] copped out.</td>
</tr>
<tr>
<td>6/19/00</td>
<td>0</td>
<td>1</td>
<td></td>
<td>[A recent increase in gas price] makes the 80-mpg care envisioned by the PNGV much more desirable... PNGV must not become a political football.</td>
</tr>
<tr>
<td>7/3/00</td>
<td>0</td>
<td></td>
<td></td>
<td>(Expresses frustration for NHTSA waste.)</td>
</tr>
<tr>
<td>9/4/00</td>
<td>1</td>
<td>1</td>
<td></td>
<td>... the government has been understanding about this industry. That includes Congress as well as the executive branch with all of its agencies that regulate the business.</td>
</tr>
<tr>
<td>9/18/00</td>
<td>0</td>
<td></td>
<td></td>
<td>(Concern for regulatory reaction to tire controversy.)</td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>9/25/00</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Concern for Congressional proposals on safety issues.)</td>
</tr>
<tr>
<td>10/2/00</td>
<td>-1</td>
<td>-1</td>
<td></td>
<td>(Critical of federal plan to put rollover ratings on new cars/trucks.)</td>
</tr>
<tr>
<td>1/8/01</td>
<td>0</td>
<td></td>
<td>1</td>
<td>The outgoing Clinton administration has given the auto industry its wish [regarding standards to limit sulfur in diesel fuel].</td>
</tr>
<tr>
<td>1/29/01</td>
<td></td>
<td></td>
<td>1</td>
<td>President Clinton went a long way toward correcting an injustice when he commuted Tony Frink’s prison sentence...</td>
</tr>
<tr>
<td>2/26/01</td>
<td></td>
<td></td>
<td></td>
<td>(Suggests building on PNGV with consumer tax credits.)</td>
</tr>
<tr>
<td>3/5/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Surprised that CAFE was being discussed by the Bush administration when it hadn’t during Clinton’s presidency.)</td>
</tr>
<tr>
<td>4/2/01</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Criticizes domestic content labels on new cars and trucks.)</td>
</tr>
<tr>
<td>4/9/01</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>...funding for [PNGV] could be cut, and it couldn’t happen at a worse time.</td>
</tr>
<tr>
<td>4/16/01</td>
<td>1</td>
<td></td>
<td></td>
<td>It was honorable—and sensible—of the Bush administration to refrain from automatically whacking [PNGV]...</td>
</tr>
<tr>
<td>5/21/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Discussion of Clinton administration’s CAFE freeze.)</td>
</tr>
<tr>
<td>6/18/01</td>
<td></td>
<td></td>
<td></td>
<td>(Discussion of possible regulation of Xenon headlights.)</td>
</tr>
<tr>
<td>7/9/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Notes possible action on CAFE.)</td>
</tr>
<tr>
<td>7/23/01</td>
<td>0</td>
<td></td>
<td>0</td>
<td>(Echoes March 5 column.)</td>
</tr>
<tr>
<td>7/30/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Makes recommendations on improving CAFE standards.)</td>
</tr>
<tr>
<td>8/6/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Discusses NHTSA consideration of safety vs. fuel economy.)</td>
</tr>
<tr>
<td>8/27/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Discusses Ford’s use of Japanese supplier for components in “clean” vehicle.)</td>
</tr>
<tr>
<td>9/10/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Notes challenges NHTSA faces.)</td>
</tr>
<tr>
<td>9/17/01</td>
<td>0</td>
<td></td>
<td></td>
<td>(Ponders how auto industry can help nation address national security, post September 11. Mentions experience working with government in PNGV.)</td>
</tr>
<tr>
<td>10/15/01</td>
<td></td>
<td></td>
<td>0</td>
<td>(Discussion of NHTSA and Ford/Firestone tire controversy.)</td>
</tr>
<tr>
<td>11/26/01</td>
<td>-1</td>
<td></td>
<td></td>
<td>(Criticizes proposal to refund tax payments to major corporations.)</td>
</tr>
<tr>
<td>12/17/01</td>
<td>0</td>
<td></td>
<td></td>
<td>(Advocates for EPA discussion with auto industry on clean air rules.)</td>
</tr>
<tr>
<td>1/14/02</td>
<td></td>
<td></td>
<td>1</td>
<td>Regulators, automakers and taxpayers should be encouraged that the FreedomCAR effort is being modeled on the discontinued [PNGV] program from the 1990s.</td>
</tr>
<tr>
<td>2/4/02</td>
<td></td>
<td></td>
<td>-1</td>
<td>When the Clinton administration created [PNGV] as a political alternative to raising CAFÉ standards, the Big 3 used the cover to improve horsepower, not fuel economy.</td>
</tr>
<tr>
<td>5/13/02</td>
<td></td>
<td></td>
<td>1</td>
<td>(Lauds a court decision to uphold rules to reduce sulfur levels in diesel fuel.)</td>
</tr>
<tr>
<td>5/20/02</td>
<td></td>
<td></td>
<td>1</td>
<td>(Applauds federal opportunity to revisit CAFÉ standards.)</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY

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Crain, Keith, “Joint research ought to include Japan -- someday,” Automotive News, June 8, 1992, p. 12.


_____, “It will be different,” Automotive News, November 16, 1992, p. 12.


______, “Clinton, Big 3 are friends, but it's just a start,” *Automotive News*, January 17, 1994, p. 12.


DOE—See U.S. Department of Energy.


EPA—See U.S. Environmental Protection Agency.


GAO—See U.S. General Accounting Office.


Interview with industry technical staff A, near Detroit, Mich., November 17, 1998 (name withheld on request).

Interview with industry technical staff B, near Detroit, Mich., November 17, 1998 (name withheld on request).

Interview with industry technical staff C, near Detroit, Mich., November 17, 1998 (name withheld on request).

Interview with industry technical staff D, near Detroit, Mich., November 18, 1998 (name withheld on request).

Interview with industry technical staff E, near Detroit, Mich., November 18, 1998 (name withheld on request).

Interview with industry technical staff F, near Detroit, Mich., November 18, 1998 (name withheld on request).

Interview with industry technical staff G, near Detroit, Mich., November 18, 1998 (name withheld on request).

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Interview with industry manager A, near Detroit, Mich., December 10, 1999 (name withheld on request).

Interview with industry manager B, near Detroit, Mich., December 14, 1999 (name withheld on request).

Interview with industry manager C, near Detroit, Mich., December 14, 1999 (name withheld on request).

Interview with industry manager D, near Detroit, Mich., December 15, 1999 (name withheld on request).

Interview with industry manager E, near Detroit, Mich., December 15, 1999 (name withheld on request).

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Interview with government manager B, Washington, D.C., September 28, 1999 (name withheld on request).

Interview with government manager C, Washington, D.C., October 5, 1999 (name withheld on request).

Interview with government manager D, Washington, D.C., October 14, 1999 (name withheld on request).

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Interview with government policy official B, Washington, D.C., November 30, 1999 (name withheld on request).

Interview with government policy official C, Washington, D.C., December 8, 1999 (name withheld on request).

Interview with government policy official D, Washington, D.C., December 8, 1999 (name withheld on request).

Interview with government policy official E, Washington, D.C., December 29, 1999 (name withheld on request).

Jewett, Dale, “USCAR chief’s goal is Big 3 harmony,” *Automotive News*, April 7, 1997, p. 56.


NEC/OSTP—See Executive Office of the President, National Economic Council and Office of Science and Technology Policy.


NRC—See National Research Council.

NSTC—See National Science and Technology Council.


OTA—See U.S. Congress, Office of Technology Assessment.


PCAST—See Executive Office of the President, President’s Committee of Advisors on Science and Technology.


PNGV—See Partnership for a New Generation of Vehicles.


USCAR—See U.S. Council for Automotive Research.


The White House, Office of the Press Secretary, “Historic Partnership Forged with Auto Makers Aims for 3-fold Increase in Fuel Efficiency in As Soon As Ten Years,” September 29, 1993b, p. 3.


