V. RETROFIT PROGRAM PARTNERS AND CONSTITUENTS

A. Elements and Methods for Building Constituency and Successful Partnering

BACKGROUND AND INTRODUCTION

Retrofitting diesel engines with supplemental exhaust emission controls dates to the 1960s and 1970s when DOCs were first installed on offroad diesel engines for occupational health reasons. In the 1980s, retrofit activity continued to focus on offroad engines, but several highway retrofit programs were initiated that involved both DOCs and DPFs. In the 1990s, a growing number of retrofit demonstration programs were initiated in the U.S., Latin America, Europe and Asia. Also in the early 1990s, the U.S. EPA, in response to a 1990 Clean Air Act Amendments mandate, established the Urban Bus Retrofit/Rebuild (UBRR) Program. This program required certain transit buses in large metropolitan areas to install technology at the time of engine rebuild to reduce PM emissions. Tens of thousands of buses were involved in the program and the principal technology utilized was the DOC.

In 1994, occupational health authorities in Germany and Switzerland required that DPFs be installed on underground mining and tunnel equipment, and in 1998, the Swiss EPA extended this requirement to all construction equipment. Sweden established its Clean Cities program requiring trucks and buses to meet certain emissions requirements that has resulted in a number of heavy-duty vehicles being retrofitted with DPFs. In the current decade, EPA implemented its Voluntary Diesel Retrofit Program (along with several subprograms) and CARB initiated its Diesel Risk Reduction Program under which mandatory reductions in PM emissions from selected fleets of trucks, buses and offroad engines have been or will be established. **Today, over 500,000 highway and offroad diesel engines have been retrofitted worldwide**. The magnitude of the success of these programs could not have been achieved without the effective use of program partners and willing equipment/vehicle fleet participants.

As awareness of advances and improvements in equipment and fuels has grown, government agencies (particularly those at the state level dealing with mandated air quality compliance goals that must be met in the years to come) have become increasing interested in promoting retrofit programs as a key component of a broader air, energy, and environmental management strategy. So, the need to involve a broader array of program partners is even greater.

A wide range of retrofit technology strategies is available to suit nearly any vehicle/ equipment application in operation today, although the current availability of verified retrofit products for offroad applications is limited. These technologies generally deliver the operating and emission reduction results that are claimed for them. In instances where problems have arisen, they were frequently attributed to:

- Technologies that were extended to marginal applications, as an experiment in a pilot project to evaluate the limits of the technology.

- Sulfur levels in the fuels that were too high for successful application of the technology.

- Mechanical problems (such as the failure of retrofit equipment brackets).

- Failure to properly monitor performance/problems of the retrofit technology.

In most instances where technological problems occurred, effective use of program partners allowed corrections to be identified and implemented in subsequent programs. In other cases, problems could be traced directly to insufficient or inadequate knowledge on the part of users or program creators/administrators. As with any other new or unfamiliar technology products, successful use requires an understanding of product function, proper installation and use, attention to recommended product selection criteria, and operating and maintenance requirements, as outlined in Section VI of this volume.

Some retrofit project planning decisions have been made with good intentions, but with poor consequences. This suggests a need for retrofit program and project planners to either obtain expert assistance or otherwise develop a thorough understanding of the perceptions of retrofit product users and their concerns for operational trade-offs to determine an acceptable level of technology performance. Program/project planners need to be aware of not only the benefits, but the challenges as well of various emission reduction strategies. They simply cannot specify that emission reductions be accomplished with the "best available technology", which could result in the application of a highly effective technology (e.g., DPFs) on equipment or vehicles with incompatible operational characteristics that would lead to overall project failure. As further described in Section VI of this volume, care, knowledge and insight also need to be applied to vehicle/equipment selection so that any desire to "improve the entire fleet" does not result in wasting money on retrofit products being installed on equipment/vehicles that are to be retired from service in a short time, or being installed on late model equipment/vehicles that are already equipped with a high level of emission control technology.

Overall, successful retrofit programs have been characterized by the following characteristics:

- Careful planning, including recruiting the necessary partners, setting the goals for the program, and building support on the part of participating fleets.

- One or more project "champions" to oversee program planning/implementation and the technological aspects of the program.

- Continuous communications with all participating parties.

- Strong, competent, and effective technical support to address and solve technical problems as they arise.

- Education and training that allows careful evaluation and selection of technologies.

- Adequate funding to conduct the program and address all program facets.

These "benchmark" elements of a successful program are fundamental to building constituency and successful partnering.

BASIC STEPS IN DEVELOPING RETROFIT PROGRAM CONSTITUENCY AND PARTNERS

Regardless of whether a retrofit program is designed for mandatory compliance or voluntary participation, the foundation that allows the development of a retrofit program constituency and partners consists of:

- *Understanding* – of the needs of the fleets participating in the retrofit project or program.
- *Trust and Confidence* – in the implementing agency to provide objective, consistent, and high quality information needed to carry out an effective program or project.
- *Commitment and Continuity* – on the part of all program participants to carry out their respective functions, especially for any financial assistance that will be needed to implement the program or project.
- *Support* – to provide fleets that will undertake the installation and operation of retrofit products with competent technical assistance and the training to operate and maintain the retrofit products properly and effectively.

The remainder of this section outlines the process for building this foundation by:

1. Developing an effective program plan that is built on a good understanding of the fleet markets in which retrofit products are to be used.
2. Recruiting necessary partners and fleet participants. This is frequently enhanced by using government fleets to set good examples for private sector fleets to follow.
3. Developing and implementing effective communications with all program participants.
4. Developing an effective technical support function.
5. Providing the means for evaluating program progress.

DEVELOPING AN EFFEFCTIVE PROGRAM PLAN

Section II of this volume addresses the major elements in developing an effective retrofit program, and describes the technical functions needed to arrive at logical implementation initiatives. The flow charts contained in Section II illustrate all of the steps needed to develop an effective program plan. This section describes the program planning functions that are needed to gain and retain retrofit program participants.

Development of an emissions inventory (See Section II) and providing supplemental information on the potential emission-related exposure risks provides the reference base and

rationale for establishing retrofit program/project need and answers the question "why are we doing this?" Metropolitan regions that are dealing with nonattainment status can provide even greater illustration of the need for a retrofit program and the attendant health benefits and positive environmental impacts that can result from instituting one. Supporting information should be developed to underscore the need to improve air quality for metropolitan and high population centers, as well as rural areas where regular fleet routes and use of offroad equipment may impose risk factors that retrofit programs might help mitigate.

Mandatory Programs

Development of a mandatory retrofit program requires special considerations and an even higher degree of thoughtfulness in planning than does a voluntary program. In establishing a mandatory retrofit program, a number of factors must be considered. The primary consideration is whether the entity seeking to impose a mandatory retrofit program possesses the legal authority to do so. Issues that must be considered include the:

- Category of vehicles or equipment covered.
- Level and type of controls required and alternatives.
- Compliance strategies allowed.
- Technology approval process.
- Enforcement methods/process to be used.

The development and implementation of the critical elements of a mandatory program can all be enhanced with effective planning that includes education, outreach, and feedback from customers or the public, as appropriate, and analytical work to assess realistic expectations for emission reductions and costs to implement. In designing the regulatory initiatives for California, for example, CARB has opted to provide considerable flexibility in meeting the applicable PM emission reduction requirements. CARB has also conducted extensive outreach with the regulated fleet to provide information and address concerns expressed by the affected fleets, and has endeavored to provide adequate lead time in meeting the applicable requirements.

Voluntary Programs

In cases where substantial Federal funds are used to support a major action that may affect the environment, an Environmental Impact Statement (EIS) is required to be developed. This document describes the positive and negative effects of the project, and actions that may be taken during the decision-making process. An EIS contains a section describing provisions for Environmental Performance Commitments (EPCs) that specify specific actions to be taken to help mitigate any negative environmental impacts. These actions can be integrated with the overall retrofit program planning functions to provide for a broad-based retrofit initiative. Another concept that can support a broad-based community-wide retrofit initiative is the use of Community Benefit Agreements (CBAs). The CBA concept was pioneered by the Los Angeles Alliance for a New Economy (LAANE), which in 1998, worked with the Los Angeles City

Council to incorporate community benefits provisions into the development agreement for a large retail project in the heart of Hollywood. Subsequent CBAs were developed for other major site development projects in the Los Angeles area, and many communities across the country (including Denver, Seattle, Milwaukee, Miami, New York, and New Haven) are using the CBA model to achieve environmental benefits associated with large-scale development projects.

Section II of this volume also describes the characteristics of various offroad market segments, and the need to have a thorough understanding of them as the basis for developing an effective program plan. Doing so will show potential equipment/vehicle fleet operators that the homework has been done to understand their needs. The program plan should illustrate the results of the market analysis and the rationale for selecting the specific offroad markets/fleet types to be addressed in the program or project(s). The analysis should identify markets and fleet types where there is likely to be a significant benefit associated with emission reductions and identify "high potential" fleets to be targeted.

RECRUITING NECESSARY PARTNERS AND FLEET PARTICIPANTS

An effective retrofit program/project needs fleet participants and an array of program/ project partners. Recognition that fleet participants are the true "customers" of the retrofit program/project will provide the perspective needed to develop positive, effective relationships with them. The results of the market analysis work described above provides the basis for carrying out detailed fleet identification with subsequent one-on-one contact with equipment/ vehicle operators to overcome their concerns about implementing retrofit technologies into their fleet operations. The overall approach to gaining the positive participation of fleet participants can be summarized as follows:

1. Identify the equipment/vehicle fleets in the locale.

2. Characterize the fleets.

3. Assess the potential of these fleets to accept and beneficially use retrofit technologies.

4. Market to those fleets that offer the best potential.

An important strategy that has been used to build confidence in the private sector for using retrofit technologies is to promote the funding of retrofit projects in government-owned/operated vehicle and equipment fleets as "leader/example fleets". As such, the focus of many of these retrofit programs is on diesel engines used in large, public-sector vehicle and equipment fleets, as a means of building "confidence transfer" to private sector fleets.

Many of the partners in U.S. retrofit projects consist of Federal, state and local agencies, as well as multi-state consortiums. Examples of such are EPA, U.S. DOT and U.S. DOE on the Federal level. Partnering by these agencies often involved being the major source of funding and has sometimes included program and technical support. State agency participants include those representing air quality, transportation, and public works functions, MPOs, RPOs, national and local citizens groups and air-quality advocacy organizations (e.g., the American Lung Association, Environmental Defense) as well as state-funded universities. Although not a

source of funding, state universities provided use of equipment, such as dynamometers and emissions measurement instrumentation, and conducted emissions testing and data logging on participating vehicles. Regional consortiums, which often provide technical assistance, guidance for program requirements, and sometimes funding, have been involved in a number of retrofit projects. Examples include NESCAUM, the West Coast Collaborative (EPA Regions 9 and 10), Diesel Solutions (the PSCAA and other public and private sector partners), the Philadelphia Diesel Difference, the Northwest Pollution Authority, various port-related initiatives, and various Clean Cities Coalitions. Also partnering in retrofit projects are technology providers, product suppliers, and fuel suppliers. Independent technical consultants or professional technical services firms are partnering sources that provide technical assistance of various forms.

The effective use of program partners is essential to the development and implementation of a successful retrofit program/project. Development of these partner relationships requires an understanding of functions that need to be provided for serving participating fleets (recognizing that the participating fleets are the "customers" of the program/project), initiative and effort in developing the relationships, and careful selection of partners to fulfill their intended roles, all of which is identified and delineated in the program planning process.

EFFECTIVE COMMUNICATIONS

An effective retrofit program includes an effective communications element within it. Successful retrofit programs have recognized this and developed effective communications mechanisms to support all facets of the program.

The communications process begins with the project planning function where the goals and objectives of the project are established, initial partners/participants are identified, funding needs and sources are identified, and the need for any environmental impact studies are delineated. Preliminary planning meetings should be conducted with all involved project participants to discuss individual roles and agree on a timeline for achieving each of the project's goals. These discussions should provide time for all parties to present issues important to them (e.g., health effects, impacts on fleet operations, cost of operation, etc.). Using a questionnaire to identify interests and priorities can provide useful information and help to build consensus. During this process, there is considerable value in talking to individuals and organizations that have participated in other retrofit projects. These contacts can provide insights into problems they have encountered, solutions they discovered, and successful program strategies that have been employed.

Workshops and conference sessions with technical and trade groups that represent the partners and participants in the program and others in the area that are concerned with air quality issues can be a very useful method for extending the retrofit program communication function beyond those directly involved in the program and build a broader base of constituency. For example, offering to develop a presentation for the Airport Council International (ACI) Environmental Committee's conference, can help to assist their members in addressing air quality issues confronting the airport sector, particularly since commercial aviation is the fastest growing segment of the transportation industry. An effective diesel emission retrofit program can help to address concerns of this group associated with the General Conformity process, the move to more strongly link airport air quality planning to regional air quality planning, and the push to treat airports as point sources of air pollution. In the General Conformity process, airports seeking to expand must demonstrate that their development will not hinder a region's movement toward attainment of ambient air quality standards. This is not simply another environmental hoop to go through. It will offer serious challenges to many airports.

Emission reduction programs that rely on a fuel-based strategy will need to address a broader base of constituents, and may include the need to develop an "anchor site", a primary fueling site that supports one or more fleets that are critical to creating a volume of fuel use to attract a fuel supply source where both the fuel provider and fleet users can benefit. Careful planning will need to be accomplished to address the myriad of issues associated with fuel supplier/user needs. The key to the success of a fuel-based strategy is to include business partners who play a significant role in using the fueling facility, and thus create sufficient market demand to make the incremental cost of the fuel affordable to users. For example, if municipal transit buses are to be fueled with ULSD, recruiting other public and private fleets to fuel with ULSD could result in considerable fuel cost savings. In addition to one-on-one marketing, a seminar should be developed to communicate essential information to the public and private sector fleet operators that intend to be involved with the fuel-based strategy.

THE NEED FOR AN EFFECTIVE TECHNICAL SUPPORT FUNCTION

Experience from programs in the U.S. has shown that the most successful ones were best equipped to deal with problems by having solid and sustained technical support throughout the project. That support came from a variety of sources including most often the technology manufacturer and/or the technology supplier, but also from the U.S. EPA (both headquarters and the regional offices), multi-state regional organizations such as NESCAUM, local air quality districts such as the PSCAA, independent technical consultants, and personnel from other fleets that had experience with retrofits. As the number of retrofit programs grows exponentially, finding well-qualified sources of technical support will become more challenging.

The examples immediately below illustrate the importance of effective and competent technical support to the fleets that are using retrofit technologies in their equipment/vehicles. A key to a successful retrofit program is taking the necessary steps to properly match the technologies to the fleet vehicles. This requires the technical capability and knowledge of technology providers or other technical experts to assist in:

- Gathering fleet information (e.g., engine and vehicle makes and model years, annual operating mileage/hours, engine condition, exhaust system configuration, ambient

temperature, access to install the retrofit device, maintenance records, and expected retirement date) to determine which candidate vehicles and/or equipment is best suited to received specific types of retrofit technologies. Guidance also needs to be provided to assist in selecting vehicle/equipment for retrofitting so that **vehicles/equipment are not retired before the full benefit of the retrofit products can be realized**. Typically, vehicles/equipment to be retired within three to five years of retrofit installation will not realize the full value of the retrofit products.

- Conducting exhaust temperature data logging when appropriate (e.g., when DPF use is contemplated). If DPFs are being contemplated for a project, exhaust temperature data logging should be performed on candidate fleet vehicles early in the planning process to determine if the vehicles are a good operating match with DPFs. If DPFs are not appropriate, the use of other, more appropriate retrofit technologies should be explored.

- Projects involving a fuel-based strategy, consideration giving to fuel supply logistic aspects, particularly if the project is to involve multiple vehicle/equipment operators such as those found at a construction site. Some issues, such as the need to respect the fuel supplier agreements for each of the participants, and accommodate individual vehicle/ equipment refueling requirements may be difficult to address or obtain agreement among the participants. Technical support to address these issues should be accomplished early in the project planning process to avoid potential problems after the project has begun.

- Tracking issues related to the compatibility of engine and fuel storage components with ULSD. There is the potential for mixing with diesel fuel of higher sulfur content and related depot storage issues, as well as the anticipated need to address the impact of reduced fuel lubricity on engine fuel system components such as fuel pumps and injectors. The use of effective technical support in addressing these issues can alleviate any problems that may arise during the time period needed to complete the conversion. Timely tracking of anticipated issues and problems will contribute substantially to the longer-term success in meeting the schedule and completing the fleet conversion.

EVALUATING PROGRAM PROGRESS

U.S. retrofit projects have typically involved either a qualitative or quantitative evaluation process. A majority of retrofit programs carried out to date base their progress on the number of vehicles/equipment retrofitted, either as a number of total retrofits planned or based on an annual percentage of retrofits completed. These programs also measure success by the sustainability of the project and the degree to which they can garner on-going community support. One way of determining community support is by way of pre- and post-retrofit surveys. Not only can these surveys be distributed to the community, but drivers, maintenance supervisors, fleet service technicians/managers, administrators, and others affected by the retrofit program can also be considered when conducting a survey.

Other programs have evaluated their projects qualitatively through observations of reductions in visible smoke output and odors at the tailpipe, as reported by the vehicle/equipment owner/operator during walk-around and pre-trip inspections. Still, other projects base success on much simpler terms. One project involving DOC retrofits on construction equipment declared

success because the construction workers have embraced the project as essentially "hassle free". Another project based success on whether all of the funding was used, while another evaluated its project success rate on how many other fleets in its area adopted retrofit technologies and anti-idling polices.

Quantitative evaluations, in most cases, require additional funding and additional resources to facilitate testing of retrofitted vehicles and equipment. Consequently, the overwhelming majority of U.S. retrofit projects established over the last five years have not included emission testing. If sufficient funds are available or required as part of a grant, emission testing, opacity testing and durability testing usually top the list. Emission testing has been performed using a variety of techniques including mobile chassis dynamometers and laboratory chassis and engine dynamometers. In those cases where testing data was reported, it was very consistent with data reported in the literature. In the absence of emission testing, emission reduction calculations are often times made using publicly available information such as the levels of emission control for which a given technology has been verified by either EPA or CARB. In some cases, programs have relied on information provided by the technology supplier.

Emission testing as a means of identifying equipment/vehicles needing maintenance and repair is discussed in Section XIV of Volume 2.

A number of projects quantified the success of the program in terms of the number of installation, maintenance, or operational problems that occurred. For example, one project evaluated the number of road calls resulting from high backpressure incidents on DPF-equipped vehicles and recorded them to help assess the durability of the technology. In another project, an engine manufacturer performed injector testing after ULSD and biodiesel pilot programs were complete to evaluate long-term engine wear.

Regardless of the measures used to assess program progress, the need exists. Specific measures can be qualitative, quantitative, or a combination of both. Everyone involved in a retrofit program/project deserves to know the level of progress that is being made, and their respective contributions to achieving progress. Also, project evaluations, both qualitative and quantitative, are extremely helpful to others that are considering retrofit projects.

B. Understanding Equipment and Vehicle Fleet Perspectives Regarding Retrofit Programs, and Factors of Importance to Them

UNDERSTANDING FLEET PERSPECTIVES

As was pointed out in Section A above, a major factor in the success of a retrofit program/project is the realization that equipment/vehicle fleets are the true customers of the program. All fleets also have their respective customers to serve, and the equipment/vehicles used to accomplish that purpose have significant costs relative to their acquisition, operation and maintenance. It does not matter whether the fleet is privately owned or owned by a public entity, the need to minimize acquisition, operating and maintenance costs, while delivering excellent services to its customers, is the goal of every competent fleet manager. Private and public sector fleet operators try to minimize their operating and maintenance costs to minimize the overhead

burden within their respective operation. Understanding the mission and factors of importance to each equipment/vehicle fleet operator desired to be included in a retrofit program/project is essential to structuring and executing an effective program/project.

Effective and consistent technical assistance can go a long way to creating a positive, yet realistic perception regarding a fleet operator's view of being involved in a retrofit program. Retrofit technology and product selection should be guided and accomplished with the knowledge in mind of the operating and maintenance capabilities of the equipment/vehicle fleet. Also, explaining why a retrofit program is being proposed in a non-threatening and positive manner helps to build fleet cooperation. Fleets that will not have the time and attention to devote to complying with recommended practices for installation, operating and maintenance, should be guided to consider technologies and products that require minimal care and attention. In selecting technologies for a retrofit program, a balance must be struck among:

1. The need for achieving desired emission reductions.
2. Complexities of program/technology implementation.
3. Working within technical capabilities/limitations of the fleet.
4. Available funding.
5. Other program goals.

FACTORS OF IMPORTANCE TO FLEETS

Factors of importance to any fleet in acquiring and using retrofit technologies are listed below. In structuring a retrofit program plan, sufficient discussion with candidate fleets (typically in a workshop environment that can be highly effective in establishing working relationships with fleets) will identify the major concerns of fleets and provide insight for the means to address them.

Facility Factors:

- Operating facility modifications needed to allow use of retrofit products.
- Maintenance facility modifications needed to allow use of retrofit products.
- Space needs for additional equipment to support use of retrofit products.

Operating and Maintenance Factors:

- Equipment/vehicle limitations created by installation of retrofit products.
- Ability to accept variations in route/duty cycle caused by using retrofit products.
- Equipment/vehicle range limitations caused by use of retrofit products.

- Equipment/vehicle fuel consumption impacts caused by use of retrofit products.
- Equipment/vehicle maintenance requirements for the retrofit products.
- Fueling facility maintenance requirements associated with the retrofit products.
- Degree and complexity of personnel training requirements for proper installation, use and maintenance of retrofit products.

Cost and Economic Factors:

- Minimum threshold (how many pieces need to be retrofitted) for a meaningful program.
- Availability of incentives to support acquisition of retrofit products.
- Incremental equipment/vehicle cost of retrofit products.
- Incremental fuel cost associated with retrofit products.
- Fueling infrastructure cost to support retrofit products.
- Costs for facility improvements/modifications to support the retrofit products.
- Costs for personnel training.
- Incremental vehicle maintenance costs associated with retrofit products.
- Incremental fueling facility maintenance costs associated with retrofit products.
- Incremental maintenance inventory cost to stock repair and replacement products.
- Economic benefits to the local area that result from purchase and of retrofit products.

Safety and Environmental Factors:

- Emission reduction benefits attributable to use of retrofit products.
- Knowledge/understanding of health/safety aspects with use of retrofit products.
- Safety and security considerations associated with use of retrofit products.
- Ability to use emission reduction benefits to satisfy SIP, conformity or other form of emission "credit" requirements.

Implementation and Market Factors:

- Implementation complexity.
- Implementation timing issues.
- Product availability.
- Fuel availability.
- Technology extinction considerations.
- Technology supplier considerations.
- Fuel supplier considerations.

SPECIAL CONSIDERATIONS FOR FUELS STRATEGIES

Use of any fuel strategy in a retrofit program requires a **systems approach** to addressing all of the needs to allow this strategy to be successful. Changing from one fuel "system" to another is a process, not an event, and requires commitment of parties involved at all levels in the program. For projects involving fuel technologies (e.g., ULSD, biodiesel, diesel fuel emulsions) consideration must be given to fuel supply logistic aspects. If a project is to involve multiple equipment/vehicle operators such as might be found at a construction site, issues such as the need to respect the fuel supplier agreements for each of the participants, and accommodate individual vehicle/equipment refueling requirements may be difficult to address or obtain agreement among the participants. These issues should be addressed early in the project planning process to avoid potential problems after the project has begun. Experience has shown that proper attention to current and potential fleet locations are needed to locate refueling sites with the greatest probability of success. This analysis takes into account the economic concerns of the fleet operator, the human dynamics of the individual equipment/vehicle operators as well as capital and operational costs.

The cost (or incremental cost) of the fuel is only one component of the system. Additional cost items include:

- Costs related to any equipment/vehicle or engine modifications required for fuel use.
- Fuel storage/dispensing equipment characteristics and costs.
- Equipment/vehicle storage and maintenance facility characteristics and costs.
- Fuel handling characteristics (personnel) and costs.

Fuel "system" selection should be accomplished with the knowledge in mind of the operating and maintenance capabilities; and facility, operating, personnel and financial constraints of the fleet.

In addressing the opportunity for implementing a fuel-based retrofit strategy, fleets will need to:

1. Set overall objectives (to decide why the fuel strategy should be selected)

2. Perform a rational assessment of options and issues (to determine what needs to be done to allow the fuel strategy to work well within the specific fleet environment).

3. Determine a realistic time frame for accomplishing the transition to the new fuel.

4. Determine the costs that will be required to implement the new fuel, and the financial commitment that will be needed to sustain it, realizing that the costs to continue the fuel strategy will continue after any grant money is expended. For those projects using ULSD and a sulfur sensitive technology (e.g., DPF), an issue can arise when funding for the project ends before the equipment/vehicle is ready to be retired. In cases where outside funding ceases, the fleet operator is faced with the decision whether to remove the technology that requires the use of ULSD and switch back to regular diesel or to continue to pay the incremental cost for ULSD. The latter option can result in substantial additional operating costs, particularly in areas where ULSD is not readily available and the cost differential is relatively high.

5. Find suppliers for all of the equipment and fuel (including back-up suppliers) that will be needed to achieve the fuel-based strategy objectives.

Other preparations must be accomplished for projects involving a different fuel. If the project calls for storing the new fuel in an existing diesel fuel tank, it is advisable to take the precaution of cleaning fuel tanks or installing new fuel storage tanks prior to implementing the program. Special handling to prevent sulfur contamination is also necessary for delivery of ULSD to the fleet location. Pre-installation maintenance on the equipment/vehicles is also most likely necessary when utilizing biodiesel; the fuel tanks have to be cleaned and the fuel filters have to be replaced.

To minimize problems with diesel retrofit products designed to operate with ULSD, measures need to be established to prevent misfueling of vehicles with diesel fuel of higher sulfur content. Segregated fuel storage and dispensing equipment (from that used for diesel fuel of higher sulfur content) is likely to be needed until ULSD becomes widespread. Users of ULSD should ensure that they purchase fuel with lubricating properties meeting those of the latest diesel fuel specifications for ASTM International D 975, Grade S15, and if fuel economy is important, that the energy content of the fuel meets the minimum requirements of the fleet.

FUNDING AND INCENTIVES

The means to pay for retrofit products is of paramount importance to fleets. Section III of this volume addresses the variety of funding mechanisms that are available to support retrofit

technology acquisition costs, but few incentives are available to support operating and maintenance costs. In addition, while there are several incentive mechanisms available to support the acquisition of retrofit products, the most successful have been direct funding via a grant process. Incentives are a critical element in initiating voluntary retrofit programs and recruiting the participation of willing equipment/vehicle fleet operators. The greatest incentive is the availability of funding that can be used for the acquisition of retrofit products or to offset increased operating costs (e.g., fuel cost differential), but incentives can take other forms as well. Incentives can include reductions in vehicle registration fees, taxes or user fees; preferential parking; or access to high-occupancy-vehicle (HOV) lanes; giving "bonus points" to contractors who commit to use low emission equipment on publicly funded projects; and giving recognition awards and/or favorable publicity to participating fleet operators.

Mechanisms of funding transfer, however, can be a significant hurdle in getting government-based grant funding to assist private sector fleets and equipment operators. For example, some government agency programs may be limited to (or preferentially support) funding of projects in nonattainment areas and as such, preclude from participating those attainment areas that are working to reduce emissions and may have sensitive populations. Many government-funded grant programs restrict funding to preclude receipt by non-government organizations, thus making it more difficult for private sector organizations to participate in grant-funded retrofit projects. Other grant programs have funding caps and/or restrictions on the percentage of time equipment/vehicles must be operated that eliminate a portion of equipment and vehicles that would otherwise be considered eligible for funding.

Achieving the involvement of private sector equipment/vehicle operators requires implementation approaches that are sensitive to their needs and are accomplished in a way that minimizes negative impact on the competitive aspects of the market in which the private operator does business. There is significant room for some creative approaches for involving private sector equipment/vehicle operators in retrofit programs in ways that are sensitive to their needs yet achieve the goal of reducing emissions from their fleets. A brief overview of key issues related to incentives are as follows. A more complete description is contained in Section IV of this volume.

- ***Tax Incentives*** – No value for publicly-owned equipment & vehicles. Only useful if there is a tax liability to offset against. Requires major government efforts to implement.

- ***Government Grants*** – Difficult to provide directly to private sector. Value is often taxable income. Involved application process. Continued funding is uncertain.

- ***Loans*** – Generally not useful to public sector owners. Requires payback on equipment that does not generate revenue. Added cost to equipment/vehicle owners.

- ***Contract Incentives*** – No value to public sector. Significant government action required to develop/approve new requirements.

- ***Mandatory Requirement*** – Issues can be wide and varied. Significant government action required to implement. Can be discriminatory or contradict existing policies/regulations.

- ***Private Sector Funding*** – Need to agree on a scheme for "long-term" payment of cost of products plus investor return. Risk of nonpayment falls on financiers.

In working with equipment/vehicle fleets, it is important to recognize that in general, fleets have little to no experience in developing grant or other types of funding proposals. As such, the job of preparing funding proposals generally falls to the implementing agency desiring to develop the retrofit program/project. Section IV of this volume describes the process and requirements for writing effective grant proposals. Those organizations with a track record or experience and prior success are likely to be in the best position to receive additional grants to support new or expanded retrofit programs.

FLEET OPERATIONAL ISSUES

Fleets generally use a range of factors that help them to decide the point at which equipment/vehicles are replaced, and whether new equipment/vehicles should be bought or leased. These factors are important to implementing a retrofit program, since they may have an impact on the time that an existing piece of equipment or vehicle may operate with a retrofit product, or have an influence on whether an early engine/equipment/vehicle replacement strategy or low-emission engine rebuild strategy is appropriate. As such, those involved in the retrofit program planning process need to understand these fleet operational issues so that the most appropriate retrofit strategy can be selected. For example, when replacing vehicles as a means of reducing emissions under a retrofit program, the vehicles must be retired prior to the time that they would normally be retired. Thus, fleet operators should consider the relative benefits and disadvantages of spending money to accelerate equipment/vehicle retirement versus spending money for retrofit products.

Warranty-related issues are another factor of significance to fleets. These issues raise concerns for retrofit program planners to consider, and include:

- Claims made by some fleet operators of statements from some engine manufacturer representatives indicating that their engine warranty would not be honored if retrofit products were purchased from a source other than an authorized dealer of the manufacturer, even if the retrofit products from the other source were verified by EPA or CARB.

- The wide range of warranty coverage offered by retrofit product suppliers.

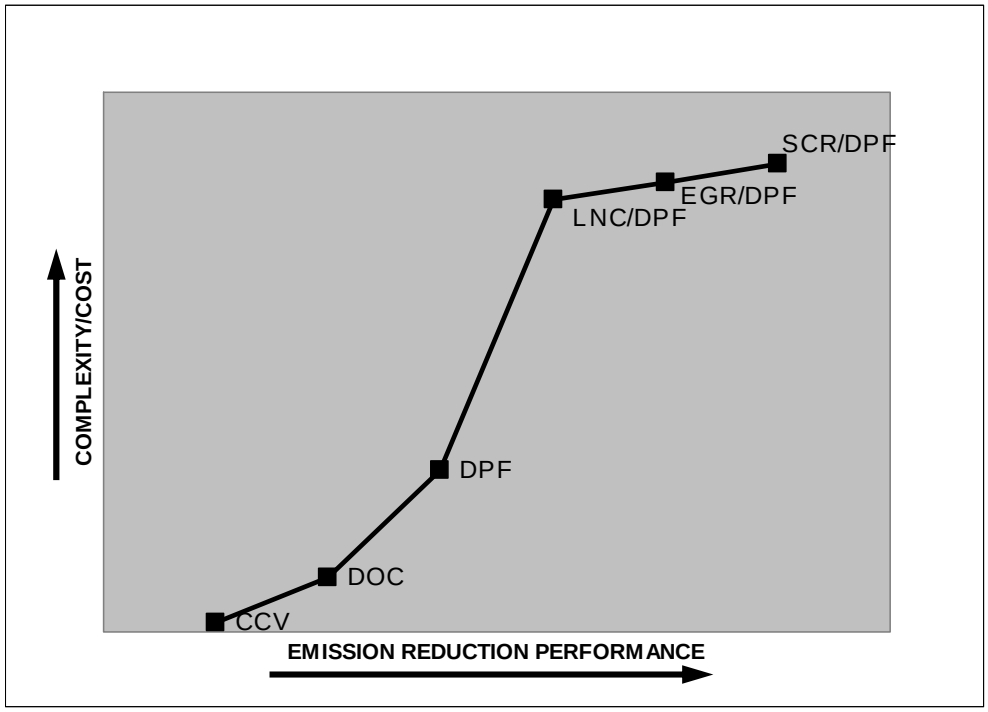
Each of these has the potential to lead to misleading conclusions, can impact product supplier/ selection decisions, and needs to be addressed during the retrofit program/project planning process.

KEY SUCCESS FACTORS

As discussed previously, the application, installation, maintenance, operation and cost of technologies varies considerably. With the exception of DOCs, most of the other retrofit technologies tend to be more application specific. Figure 5-1 illustrates the point that in general, the most complex and costly technical options provide the greatest emission reductions. For

example, DPFs provide up to 90% or more PM reduction and SCR technology provides up to 90% NO_x reduction. These technologies, however, are application specific, relatively more expensive than other PM and NO_x control technologies and technically more complex.

Figure 5-1, Retrofit Technology Performance vs. Complexity



As discussed previously, program planners need to be aware of the benefits and challenges of various emission control strategies, and not simply specify that vehicles to be retrofitted use the "best available technology", since doing so may require the use of a technically more complex technology that would likely result in at least some vehicle applications that are not suited for use with the technology. Also, in instances where more technically complex strategies are being considered, beginning with a small-scale pilot project often can be an important first step to gain experience before a large number of fleet vehicles or pieces of equipment are retrofitted. By contrast, organizations implementing retrofit programs using DOCs concluded that the application, installation and operating issues for full-scale programs have been very straightforward.

As noted above, a key to success is education, outreach, and training for fleet personnel at the very beginning of the program and throughout its duration. Every effort should be made to build a team spirit among fleet personnel. Some retrofit projects have provided special caps or shirts for participating fleet personnel. Survey of fleet personnel not only provides useful feedback but it is a way to keep fleet personnel engaged. Establishing protocols for reporting problems and corrective action is also important. It is not unusual for fleet technicians to solve problems as they occur without documenting such action. Documentation of problem, however, provides an effective mechanism for notifying the technology provider, and also helps to insure that if problems do occur, proper repairs are indeed made.

A successful program, particularly where more complex technologies are involved (DPF vs. DOC), needs to have a person or persons "on the ground" to serve as a "champion" for the technical aspects of the program. That person or persons can be the chief technician, the fleet manager, and/or someone else (e.g., a technical support contractor) who deals directly with the vehicle operators and takes the lead to guide installation, maintenance, and vehicle operation functions in order to spot problems and ensure that corrective action is taken. Programs that were successful even though they encountered some problems with technology delivery, installation, maintenance and/or operations often had dedicated technicians that worked through a number of issues and were active participants at every stage of the project.

A key to a successful project is to have a competent retrofit product supplier or other source of competent technical support that is committed to providing on-going technical support, particularly when problems arise. A project may encounter problems, but in those programs where the product supplier has been actively engaged in trying to solve the problems, the willingness of the fleet operators to support continuing efforts is much greater than in projects where the product supplier/provider is not technically competent or is viewed as being less than cooperative.

C. Public Education and Outreach

INTRODUCTION

Successful retrofit programs have stressed the importance of actively promoting participation by potentially interested stakeholders and the general public. The benefits of outreach and public participation are multi-faceted and include:

1. Building broad-based support for the retrofit program and subsequent retrofit initiatives.

2. Promoting interest with other fleets to become involved.

3. Identifying new sources for funding.

4. Helping to educate the public on the needs and opportunities to reduce pollution to protect public health.

Through education and outreach mechanisms, state and local government agencies charged with meeting immediate and longer term emission reduction goals can describe to their stakeholders and the public exactly which program options are demonstrating continued progress and promise. They can also determine which programs are being slowed by technological or engineering delays that are expected to be overcome soon, and how budgetary factors are being managed to achieve results or provide evidence of the need for additional funding (or both). Private sector program sponsors and agencies soliciting private sector participants can also utilize increasing public awareness and understanding to promote voluntary efforts. Prospective fleet operators and their technicians should be involved early in the process to understand the benefits of the program, understand retrofit technology installation and operating requirements, know what maintenance will be required, and how to spot and deal with problems if they arise.

MECHANISMS

Education and outreach functions can take many different forms, and are usually tailored to suit specific needs and purposes. The retrofit program planning function should include a determination of the types of education and outreach activities to be accomplished to best help the program achieve its goals. Factors to be addressed include:

- Definition of target audiences.
- Expected outcomes the types of educational products to be produced.
- Distribution of the educational products to be developed.
- General or specific messages to be conveyed.

Educational and outreach materials and mechanisms can take several forms, including:

- Brochures and fact sheets.
- Guidance documents.
- Conferences/seminars/workshops/training sessions.
- Web sites.
- News releases and media events.
- Briefing by groups conducting retrofit projects to those considering a retrofit program.
- Establishment of advisory groups or committees.
- Establishment of "environmental performance partnerships".
- Coordination with business/industry action/advisory groups.
- Establishment of "environmental excellence" awards.
- Programs for use within schools and educational institutions (e.g., development of a "clean air curriculum" to student class programs, and/or career center automotive technician classes).

Appropriate and effective use of program partners can assist in the process of planning, coordinating, providing technical input for, developing materials, and executing all of the above. Information sharing has proven to be instrumental in public outreach and education. Some implementing entities have provided information to several environmental groups, which in turn included that information on the project in their newsletters, thus expanding the regional

audience. Information on current projects can be documented, often times on websites, and shared with other entities planning to perform retrofits

FUNCTIONS AND EXAMPLES

Many retrofit programs involve outreach and education activities to educate the public of the benefits and advantages of emission reduction in the community. The magnitude of outreach and education activities is often in direct relationship to the amount of project funding available to support them, although creative use of program partner capabilities can allow a lot to be accomplished at minimal cost to the program.

A typical outreach activity involves a project kick-off press event where members of the community, participating fleets, and government officials, and local press are invited. Facility tours have also occurred when universities are involved in the testing process of retrofitted vehicles. Independent of any requirement for public participation, promoting public and user awareness and understanding of, for example, benefits and tradeoffs involved in designing and implementing a retrofit program is important.

Once the retrofits are completed, additional press events can be held for the local media. Press packages, including fact sheets detailing the program, are released to the press and for general circulation. These are used to generate both local TV and newspaper coverage. One retrofit project example decided to develop a video summarizing the overall accomplishments and have it air on local television networks. Seminars and presentations given by the implementing entity can be held at local conferences and workshops discussing the results of the retrofit project.

Besides presenting the results and successes of the program, the vehicle/equipment involved in the retrofit project can also be displayed at conferences or workshops, typically invoking a question and answer session. In addition to the vehicle/equipment being on display, signs, banners and posters displayed on the vehicles themselves can be used to inform the public that they are low emission vehicles.

SPECIAL CONSIDERATIONS FOR FLEET PARTICIPANTS

One of the more useful educational functions that can be provided to fleet personnel (fleet managers and/or service technicians) is to provide an opportunity for them to meet with their counterparts in other fleets to share experiences and to help promote new retrofit projects.

Another important education feature of any retrofit program is the need to allocate some portion of project funding for education and training of fleet service technicians and managers. This is done, in part, so that the fleet managers and technicians have a sense of purpose for the project. They are encouraged to be in constant contact with the technology experts to obtain added educational value. Fleet service technicians should be trained on retrofit technology installations, monitoring and servicing of the technology.

When engaging fleets to participate in retrofit initiatives, over emphasis of any direct suggestion that equipment/vehicle operators or others exposed to diesel emissions face a direct health risk can become a contentious issue that may diminish fleet operator support for the program. Projects that stress improving air quality for the region in general are likely to have better success in gaining the support of fleet operators.