97.152

Prepared for: Pacific Gas & Electric Company

> 123 Mission San Francisco, CA 94177

Residential Central Air Conditioner Service Program Final Report

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January 29, 1999

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ABSTRACT

Traditional approaches to transforming a service or installation market include education, training, and marketing. Experience has shown that these three items alone have not transformed the way residential air conditioners perform immediately after installation or later after they are serviced. The Residential Central Air Conditioner Service (RCACS) project was designed to address this problem from a market transformation perspective. This project was a third-party market transformation project of the California Energy Efficiency Board.

Air conditioners and heat pumps perform well below their designed efficiency and capacity because of low airflow through the inside coil and incorrect refrigerant charge. The pertinent question is: How can we change the way air conditioners are installed and serviced to obtain the designed performance. This project was a field test of a computer expert system designed to ensure that the two critical parameters of airflow and charge are properly tested by the servicing technician. Over fifty technicians working for ten contractors were trained on the system.

The computer expert system (CES) was combined with training (classroom and on-site), consumer education (media blitz), and marketing (mass mailings, telemarketing, and "piggyback" mailings).

The research was conducted as a pilot project with an initial analysis of market actors, potential points of intervention, market barriers, and actors' motivations. This analysis was based on a ten year history of working directly with residential air conditioning technicians and customers. After the initial analysis, pre-intervention surveys and focus groups were conducted, interventions took place, and final surveys and focus groups were conducted.

It was hypothesized that the CES would be used by individual consumers on their home PCs to provide an independent second opinion about the work of the air conditioner technician. This hypothesis was rejected. Another hypothesis was that the CES would be accessed by consumers and technicians via a toll free number. This hypothesis was supported by the data. It was hypothesized that the primary marketing target should be customers who have their air conditioners serviced every year and that those customers would receive a better tune up than they usually obtained. This hypothesis was supported by the data.

The primary conclusion of the study is that the computer expert system in combination with training, education, and contractor support can result in a sustainable transformation of the air conditioner service market. This study showed that the keystone to the interaction between the service technician and the consumer is trust. Any project targeted at this interaction must build the customer's trust in the technician. Otherwise, it will be rejected by the contractor.

The most critical stumbling block in the project is the issue of timing. This market can be transformed with a targeted intervention <u>at the right time</u> in the seasonal cycle of air conditioner maintenance and use. If the intervention does not take place very early in the season (February, March, April), with immediate follow through, the opportunity is missed for another year.

EXECUTIVE SUMMARY

This program addresses the market interaction at the point of an air conditioner tune-up (usually in the spring). Using marketing, training, and incentives the program brings the contractors, technicians, and customers past initial market barriers including: information costs, performance uncertainties, and hidden benefits. Implementing an air conditioner tune-up that meets the manufacturers' standards results in positive benefits to the contractors and satisfaction of the customers' needs for a properly performing air conditioner. CheckMe![™] is a computer expert system that is "modern", independent, and user friendly. It enhances the air conditioner tune-up and maintains the interaction with the service technician as central to the process. Direct toll free access to a third party expert at the computer terminal is provided to augment the diagnostic technique of the service technician.

Desired Market Effects:

Sustainability

The first desired market effect is integration of proper diagnostic technique into the usual service of residential air conditioners. The usual service does not include checking refrigerant charge and airflow with the manufacturers' specified methods. The prevailing methods are only effective in extreme situations. This is evidenced in national studies which show: refrigerant charge off by more than 5% on 60+% of the units, airflow low by more than 50 cfm per ton on 70+% of the units, and an average estimated achievable savings between 12% and 31% depending on the local situation. Conducting a tune-up according to the manufacturers' specified methods can lead to sustainable change when it increases the trust between the contractor and owner and provides the contractor with an improved market position and improved profits.

This project reintroduced the manufacturers' specified refrigerant charge and airflow tests to the technicians and successfully got them to use these diagnostic procedures. This change is sustainable if the technician and contractor are brought beyond existing barriers:

- Performance uncertainty: Will the customers respond favorably to the change in service and will the customer end up trusting the contractor more or less?
- Inadequate infrastructure and organization practices: Technicians have not practiced these techniques.
- Information costs: The contractor assumes that it will take more time and they will have to raise their price for a tune-up. Obtaining information to dispel this assumption is considered costly and risky by the contractor.

A second desired market effect is that customers realize the increased benefit from a proper tuneup and that this realization results in additional customer trust and loyalty to the contractor. This project introduced proper technique to the consumer. The media campaign, the direct mail campaign, and the follow-up with the customer addressed the additional value of proper diagnostic technique. These supported the most effective sales point - the interaction between the technician and customer. This interaction was modified to include education about proper refrigerant testing and airflow. These interventions resulted in strong customer support of the program. This is sustainable if customers are able to overcome existing market barriers of:

- Hassle costs, information costs, and service unavailability, such as difficulty in finding a contractor that will do the job according to manufacturers' specifications
- Hidden benefits, including results not being effectively communicated to the customer

More efficient management of home energy consumption

At this time large amounts of residential energy are wasted because the usual tune-up does not discover the actual state of refrigerant charge or airflow through the coil. In fact many common procedures result in incorrect refrigerant charge in the air conditioner. This program reduces home energy consumption by ensuring that proper procedures are used during the air conditioner tune-up. There is a huge opportunity for change since approximately 25% of the AC stock is serviced every year.

Secondary targets of this program are customers that do not regularly have their air conditioner serviced. These customers wait until the air conditioner breaks down to call the contractor. A long term goal is to move a portion of customers into the regular service group with contractors that follow correct procedures. Using CheckMe[™] during a service call results in a more satisfied comfortable customer that is more likely to recommend the service to their friends and relatives who do not get regular AC service.

Success with the first group will result in reduced energy consumption and potentially referrals within the second group.

Increased consumer demand for efficient products and services

CheckMe introduces the customer to what is essentially a brand new service, the proper tune-up of an air conditioner. Prior to the program, only one contractor in Fresno had a policy that the manufacturers' specified measurements be made on every unit and enforcement was variable.

The introduction of this new service was successful where the technician was enthused about it and explained the service to the customer. This was sometimes sparked by the media campaign or the direct mail campaign. Non-participating contractors complained that their customers were calling about the CheckMe![™] service after they had already checked their air conditioner for the summer.

The satisfied customer is the best advertisement for this new service and there are a number of satisfied customers in the Fresno area. In order for the process to be effective in the long term, a critical mass of customers needs to be demanding this service. Because of the late start of this program, the critical mass does not yet exist in Fresno. The contractor focus group stressed that introducing and building the demand for a new service is a multi-year task.

Program Milestones Achieved

This project has achieved all its milestones for the existing grant. Some of these milestones include:

- a five month publicity campaign that built consumer awareness through TV news, Radio interviews, and newspaper coverage
- recruiting and training of 10 contractors and 51 technicians in proper charging techniques, use of the toll free access to the computer expert system, interactions with the customer, and use of the CheckMe![™] software (the participating contractors represented all but one of the largest residential contractors in Fresno)
- direct mailing to 80,000 household (blanket mailing), targeted second mailing to 15,000 high likelihood households, telephone follow up to second mailing
- computer expert system quality assurance implementation through toll free line and instant feedback with results review and response by technical personnel
- delivery of 15,000 copies of the CheckMe![™] expert system software
- staffing of toll free hot line with access to the CheckMe!™ computer expert system
- initial and final contractor surveys, initial and final focus groups with contractors and customers

Market Effects Observed

The closing focus groups showed both positive market effects and evidence of sustainability. The reader of this report is strongly encouraged to obtain a video tape of these focus groups for first hand observation. Quotations in the following sections are from the focus groups.

Trust is the cornerstone of a positive interaction between the contractor and the consumer. For contractors who used the system the most, performance uncertainties associated with trust were reduced or eliminated. Customers responded favorably to the new service. Simultaneously the consumer was more comfortable with the interchange because the contractor was using this high tech independent third party method of getting the air conditioner tuned properly. While many customers did not understand the technical side of the checkup, they liked the additional information and openness of the technician in providing the information. The benefits of a proper tune-up were no longer hidden. The process reduced the barrier of asymmetric information. Some focus group comments:

Technician -- "The customer loved having a third party second opinion immediately available to them."

Technician -- "First time customers love it."

Contractor -- "Regular customers asked me about the CheckMe!™ service."

Contractor -- "It is the right way to do any service."

Technician -- "People liked it because it was a computer and people believe computers."

Timing is extremely important in this market interaction. Contractors do their initial checkups (also called preventative maintenance or PM) early in the year. This avoids the rush period when

it is hot and repairs are the only focus. During the early period, contractors who want to distinguish themselves are willing to try a new process with their regular customers. In that time, the "information costs" of finding out how this will really work are reasonable. In the early period, they also have the opportunity to institute new organizational practices, spend time on training, and observe the results. This project missed that opportunity. In spite of that, a number of the contractors are interested in pursuing this project further.

Service Manager: "We could have done a lot more if it were done earlier."

Contractor: "It would have been real nice during the spring but they brought it in during the repair season. It is a service, it needs to be in the service season."

Contractor: "It needs to be a year or more."

Contractor: "March, April, May should be when the program is running."

Contractor: "It should be a three or four year program"

Contractor: "It needs to happen year round."

Non-participating Contractor: "I didn't use it partially because I couldn't afford to train my technicians that late in the season."

Retraining the infrastructure is necessary for this market transformation. The current practices are inadequate to obtain proper performance of these air conditioners and only repeated field application of the new procedures has been successful in converting the infrastructure. Companies have a number of units that they installed and serviced over the years. A substantial percentage of these units have never performed properly. With retraining and application of the system these units were brought to their proper performance.

Some examples from Technicians:

"I was surprised to find charge wrong on units I have serviced over the years. I even have found 8 ounces overcharge on brand new units."

"I did it for education. I loved it. I don't see anyone really checking charge right, most technicians only do a touch method."

"I don't want to say it is fun exactly, but it is the right way to do it. I am going to do it on every one."

"Most of those units are overcharged new --- 8 out of 10 are overcharged."

"If you do it every time you have covered the bases. It has opened a whole new thing for me."

"You learn how to be more precise."

Evidence of Sustainability

The technicians and contractors are at different stages of adopting the proper diagnostic process. The sustainability at the contractor level is dependent on how many technicians and contractors get over their initial fears. The final focus group showed a cross-section of the technician population at various stages of transformation. The technicians with the least experience with the system still thought it added significant time to the job. The technicians with more experience were both faster and had found how to sell the additional repair time.

Technician #1 (60 addresses with the system)

"It was a lot easier than it sounded."

"The only additional time I see is just the telephone call."

"In all actuality it will make you money - call the numbers in and you will make a sale (selling the actual repairs to the unit)."

Technician #2 (52 addresses)

"It was a simple procedure."

"If you do the CheckMe!™; the on the spot second opinion makes it so you pretty much have the sale on the repairs."

Technician #3 (36 addresses) (Service Manager)

"If you have no problems CheckMe!™ takes 20 minutes - realistically 30 minutes."

The sustainability is also dependent on the contractors' perception of a benefit to using the system. The contractors with the most CheckMe![™] runs have expressed new appreciation for the process. Comments from the final focus group confirm this.

Contractor: "It bailed us out on a couple of jobs where we were battling with equipment (and the customer). CheckMe![™] backed me up 100%. Having an independent party do that is great."

Contractor: "CheckMe!™ has generated more revenue for me."

Contractor: "With the system our younger technicians can get right in there and do a good job. That is a real advantage."

Contractor: "We haven't had any callbacks on CheckMe!™ jobs."

Contractor: "It is the right way to do any service."

Service Manager: "You can show pass or fail it will give you credibility."

Service Manager: "On the job today it reaffirmed that we are a legitimate contractor"

The sustainability is dependent on the technician acceptance of the procedure and the companies support for using it.

Technician: "I don't want to say it is fun exactly, but it is the right way to do it. I am going to do it on every one."

Technician: "In all actuality it will make you money - call the numbers in and you will make a sale (selling the actual repairs to the unit)."

Technician: "I am really trying to get all the technicians to do it."

Technician: "CheckMe!™ is accurate and we don't have any call backs."

Technician: "If you do the CheckMe![™]; the on the spot second opinion makes it so you pretty much have the sale on the repairs."

Service Manager: "It's a great tool that will help us. It is something that should be done by everyone no matter what."

Service Manager: "We are going to take this on no matter who is promoting it. It is our responsibility to do the job correctly."

I. INTRODUCTION / BACKGROUND

Introduction

Proctor Engineering Group (PEG) was commissioned by the California Board of Energy Efficiency (CBEE) to investigate the potential for market transformation in the residential air conditioner market.

The Residential Central Air Conditioning Service program, known as the CheckMe![™] program, was designed to provide market transformation in the residential air conditioner service industry by addressing the shortcomings of current equipment service approaches.

The present situation is such that the standard AC tune-up is of substantially less value than it could be. Customers are routinely left with air conditioners that have incorrect refrigerant charge, incorrect airflow, low capacity, and low efficiency. The CheckMe![™] program was designed to concentrate on getting the refrigerant charge and airflow set to meet the manufacturers' recommendations.

The CheckMe![™] program took place during the period of May through September 1998, in the Fresno/Clovis area.

Objectives of CheckMe!™ Project

The CheckMe![™] program was designed to provide an effective agent to ensure proper operation of residential air conditioners. The purpose of the program was to reduce the barriers present in the residential AC service industry. The project objectives were to:

- Demonstrate the ease of use and effectiveness of the program.
- Permanently transform the services provided by contractors.
- Motivate contractors to conform with manufacturers' installation and service recommendations.
- Increase consumer demand for effective service work.

The program consisted of a number of coordinated facets surrounding the customer/service contractor interchange. The core of the program was the use of the CheckMe![™] software, a computer expert system, accessible to the customer and contractor through either a toll free phone call or on the customers home computer. The software program evaluates the service work against attainable goals and makes the results immediately available to the technician and customer.

This program increased the knowledge of customers, making them better consumers. The customer was provided with a free third party second opinion to verify the information presented

by the technician. It also increased the knowledge of contractors, making them better at service delivery and better at promoting effective AC services.

Prior Research

In 1987, a field study of residential air conditioners indicated that with standard installation and maintenance, the average air conditioner efficiency had degraded significantly. It estimated a lost efficiency in the order of 30% to 40%. (Neal, 1988). As a result of the Neal report, PEG proposed an Appliance Doctor™ program to recover the lost efficiency.

These studies included high-use and high-bill complaint customers; high-bill complaint only customers; and randomly selected customers. Common to all of these pilot studies were four main elements. First, each study worked to quantify the magnitude and extent of the problems with the space conditioning systems. Second, systems were repaired to reduce or eliminate the problems. Third, systems were re-tested to determine the results of implemented repairs. Finally, results were metered to determine the true effect of these repairs.

The first study was conducted in the foothills of the Sierra Nevada in the winter of 1989/90. This program, the Appliance Doctor Heat Pump (HP) Pilot Project (Proctor et al. 1990), evaluated 51 heat pumps at 48 sites which had records of high energy use and high bill complaints from customers. The second study, the Appliance Doctor Air Conditioner and Furnace (AC-90) Pilot Project (Proctor 1991), was performed in California's Central Valley in the summer of 1990. AC-90 investigated potential energy and peak savings in the residential air conditioners and gas forced air furnaces of 15 high-bill complaint customers. The 1991 pilot program, Appliance Doctor Pre-Production Test (AC-91) was also conducted in the Central Valley (Jacobson et al. 1992). In the AC-91 test, 250 air conditioners of various user types were tested. The fourth pilot, the Model Energy Communities (MEC) Program (Kinert et al. 1992), started in late 1991, and completed work on more than 1,000 randomly selected AC units in the Sacramento River Delta.

The same problems were evident in each study: duct leakage, low airflow, incorrect charge and poor service techniques. Table 1-1 presents the findings from the four studies.

	89-90 HP	90 AC	91 A	AC Sub-met	ered	91-92 MEC
Usage	High	High	High	High	Random	Random
High Bill Complaint	Yes	Yes	Yes	No	No	No
Sample Size	51	15	15	5	16	(1) 999
Low Airflow (>50 CFM/ton low)	48%	67%	50%	40%	29%	44%
Undercharge (2)	31%	27%	27%	(3)	41%	22%
Overcharge (2)	(4)	27%	36%	(3)	(5)	33%

Table 1-1 Appliance Doctor™ Findings

1. Airflow tests were only performed on 175 of the units

2. Refrigerant charge was only tested on units that had adequate airflow.

3. Not analyzed because of very small sample size.

4. Testing methodology utilized did not detect overcharge

5. None detected

Considering the common problems in the four Appliance Doctor[™] projects, PEG created the CheckMe![™] expert system computer software to lead the service contractors through the process of measuring and correcting airflow and charge on both new installations and service calls.

II. MARKET EFFECTS STUDY

Market Characterization

The potential market for the CheckMe![™] program is all PG&E customers with central air conditioning. This market is growing and currently exceeds 22% of PG&E's residential customers.

The test market used in the summer of 1998 was Fresno and Clovis. A 1992 PG&E study estimated that 88, 425 households¹ had significant air conditioner use in the Fresno division. Approximately 25% of the customers get annual service calls to tune-up their air conditioner. The primary market in the 1998 CheckMe![™] program were those customers who were anticipated to have an AC tune-up in the spring of 1998 (estimated at 20,000 customers). A secondary target was those customers who were not planning on an AC check but might get one in response to the program.

The average performance of residential air conditioners is significantly below design performance. The average performance decrement has been estimated in field studies to be 17% or more. This is equivalent to a 12 SEER air conditioner operating at 10 SEER. This decrement is due to improper installation of new air conditioners and improper servicing of existing ones. The primary problems are incorrect refrigerant charge and incorrect airflow through the evaporator coil. These problems can be avoided by relatively minor changes by technicians in service procedures.

Market Transformation Theory

The concept behind market transformation is that the market can be permanently changed for the better by overcoming existing barriers. Market transformation is achieved by intervention in the market to stimulate a change. The transformation is considered successful when the effects of the intervention remain in place after the stimulus is removed. Market transformation in the energy efficiency sector is a method of instituting cost effective, energy efficient strategies that are currently not in demand or routinely implemented in the market place. Once the benefits of the energy efficiency measures are seen, the measures will remain in place based on their own merit.

The CheckMe![™] program was designed to transform the market by:

- Providing an intermediary (third party) to effect a change in the standard practice
- Supplying an effective mechanism (software and support) to both the contractor and the consumer
- Educating consumers so that they demand quality service of their contractors

¹ from 1990 billing data

- Supplying a means for the consumer to determine if they are receiving quality service
- Providing a means for contractors to differentiate themselves from the competition
- Increasing participating contractors' market share through increased consumer knowledge

These transformation mechanisms are directly linked to the market actors (consumers and contractors) motivations. Detailed Market Influence Diagrams were produced prior to the start of the program. These diagrams are reproduced in Appendix B pages 6, 8, 10, 13, 14, 16, 17, and 18.

Market Barriers

Market barriers are the characteristics of the market that help explain the difference between the optimum and the actual delivered service in the market place. The barriers are typically the beliefs, attitudes and awareness of the market players. The cost of the service should not be considered a barrier since the service is believed to be cost effective.

At this point in the market, the barriers to delivering effective service prevent proper operation of all but a few air conditioners. The contractor has little motivation to bring the air conditioner to their full capacity and efficiency. The homeowner has no way of determining whether their AC is operating efficiently. They can only tell if it is operating well enough to cool their house. Making sure units provide cool air, even if the efficiency is not at the level it should be, has become the standard toward which service technicians work. CheckMe![™] seeks to change that standard to cooling at top efficiency.

Overcoming the market barriers in the residential air conditioning service industry is a major undertaking. The barriers addressed by the CheckMe!™ program include:

- The contractors failure to implement the manufacturers' recommendations
- The contractors not being aware of the hidden costs associated with inadequate service
- The contractors belief that the customer is not willing to pay to get the job done correctly
- The customers lack of awareness that there is a problem
- The customers inability to differentiate between effective and inferior service
- The customers inability to locate contractors that perform effective work

Research Hypotheses

The fundamental hypothesis is:

When the results of basic air conditioner tune-ups are immediately and effectively presented to the homeowner, the contractor will perform a tune-up that meets the basic criteria of obtaining proper refrigerant charge and correcting airflow.

Additional research hypotheses include:

When contractors experience the increased market share from improved basic tune-ups, they will continue to offer and promote the improved service.

When customers experience the effects of the improved tune-up and are exposed to additional comfort, performance, and reliability possibilities, they will request these additional services (compressor winding tests, duct sealing, etc.).

When contractors experience the promotional advantage of using immediate third party software for ethical proof, they will promote that software to their customers.

When the market for third party software and hot line availability is established, this service will produce a profit for the third party and will continue to be offered.

When contractors experience the increased revenue from effective add-on services, they will continue to provide and promote these services.

These market effects are sustainable because they are built around the basic motivations of the market actors. By giving the actors the opportunity (removal of barriers) to play out their existing motivations, a sustainable long term market transformation will take place.

III. PROGRAM ACTIVITIES

The CheckMe![™] program provided a multifaceted approach to transforming the residential AC service market. The following section of the report contains brief descriptions of the work performed in each of the tasks.

Software and Data Protocol

The software and "hard copy" data entry forms were developed based on the lessons learned over the course of several years of analyzing residential air conditioning systems. Prior to implementation of the Fresno/Clovis program PEG made revisions to both the software and data gathering protocols. The activities included:

- Revising the software program to gather the information requested by PG&E
- Simplifying the software so it was more consumer oriented (rather than technician oriented)

Contractor Recruitment

One of the first tasks in the program was identification and recruitment of the local contractors. A concerted effort was made to include as many of the contractors as possible. For the program to be successful, the participation of several contractors was needed. The activities included:

- Identification of eligible contractors
- Outreach inviting the contractors to participate
- Securing contractor agreements for participation

Contractor and AC Technician Training

Once the contractors agreed to participate, their service technicians needed to be trained. The training needed to be comprehensive, covering all aspects of the program; for example: customer marketing activities, proper service techniques, software operation, etc. The activities included:

- Development of training materials and outline
- Securing training facilities, scheduling, and presenting the training sessions
- Evaluating participant comprehension of the materials based on test results
- Notifying contractors and service technicians of their eligibility to participate in the program

Marketing Campaign

One of the primary efforts of the program was to generate customer interest. Several approaches were tried to see what worked and what didn't. Proctor Engineering Group employed Staton & Hughes to develop and implement the marketing campaign. The goal of the outreach efforts were to create a demand for the service. Once the customers demonstrated an interest in the program they could then be referred to the participating contractors. The activities included:

- Mailing of program advertisements to 80,000 households
- Software delivery to over 15,000 households
- Phone bank follow-up to the 15,000 households in the blanket software mailing
- Media campaign to get the CheckMe![™] program exposure in print, on radio and television

Toll Free Telephone Support

Proctor Engineering Group established and maintained toll free telephone support for both the customers and the participating contractors. The phone support served to provide an easy way for customers to learn more about the program, get a referral to a participating contractor, or have the data gathered by the service technician run through the CheckMe![™] software. The contractor and service technicians used the telephone support for both technical assistance and getting CheckMe![™] run results. The activities included:

- Establishing two toll free phone lines (the primary line containing the program name 877-CHECKME)
- Staffing the customer phone line during normal business hours
- Staffing the contractor phone line with technical experts and providing back-up pager service when the lines were not staffed
- Providing voice mail service during non-business hours

Inspections

Proctor Engineering Group provided inspection services to supply feedback to the service technicians on the work they performed. These checks examined both the quality of the work performed and the accuracy of the data reported by the service technicians. The inspection process also allowed PEG to communicate to the customer the benefits of the service they received and verify that the work performed by the service technician was in compliance with the program standards. The activities included:

- Providing ride-along and post-service inspections of the contractors' work
- Communicating the results of the inspections to the customer, contractor, and service technician
- Gathering customer feedback on the program and the contractors' performance
- Analyzing and reporting the inspection results to PG&E

Focus Groups

Godbe Research & Analysis was retained by Proctor Engineering Group to conduct four focus groups. Two focus groups were conducted before the program and two were conducted after the program. In each case one group was comprised of homeowners with central air conditioning in the Fresno/Clovis area, and the other group was comprised of air conditioning service contractors in the Fresno/Clovis area. The purpose of the focus groups was to aid in the development and marketing of the Program, to obtain information on market effects, and thus aid in evaluation of the program. The activities included:

- Conducting pre-program focus groups with customers and contractors
- Conducting post-program focus groups with customers and contractors
- Analyzing the results of the focus groups and reporting the results to PG&E

IV. PROGRAM TIMING

The residential air conditioning industry is very cyclical. Contractors annually go through periods where there is an abundance of work, requiring them to add staff (such as in the peak of the summer season). On the other hand, they also experience periods where there is little work, requiring them to lay staff off (such as in the late fall after the summer peak and the fall tune-up season).

In order for any intervention, such as the CheckMe![™] program, to be successful, the launch of program activities must be carefully timed. Contractors in the Fresno/Clovis area typically perform their residential air conditioner tune-ups in the early Spring. The optimum time to impact the air conditioner tune-up mechanism is when urgent customer demand (no-cool calls) are at a minimum, yet it is warm enough to properly check the air conditioner. This occurs in February, March, April, and May (depending upon when warm weather begins).

The launch of the 1998 CheckMe![™] program did not meet this early deadline. The launch date of the program being late in the traditional service season was the most commonly cited reason for contractors not participating.

Customers also responded that the program had been launched too late. The phone bank session, following the software mailing, revealed that a significant number of people had already had their AC unit serviced.

Most of the major residential contractors in the Fresno area participated in the program. They collectively do thousands of checkups at the beginning of the season. These contractors insisted at the end of the program that they could do thousands of CheckMe!TM checkups if the timing was right. The experience at the end of the program supports that contention.

Proctor Engineering Group recommends that the CheckMe![™] program, or any program trying to intervene in the residential air conditioner tune-up process take place during February, March, April, and May.

V. PROGRAM PLAYERS – WHO PLAYED, WHO DIDN'T

The goal of the CheckMe![™] program was to test a market transformation mechanism by intervening in the contractor/customer interchange during the annual air conditioner tune-up process. There are four primary program players

- Contractors.
- Service technicians.
- Customers that regularly get their air conditioners serviced.
- Customers that do not normally get their air conditioners serviced.

The interaction between the contractor, or service technicians acting as a representative of the contractor, and the customer is the critical point of intervention. The eventual performance of residential air conditioners is determined at this point. The goal of the CheckMe![™] program is to provide a tool that allows the customers to determine if they are receiving effective service and for the contractors to establish that they are providing effective service. The ultimate goal is to cause Market Transformation by 1) demonstrating to the contractors that they can make a greater profit by providing superior service and; 2) demonstrating to the customer that they can be confident their air conditioner is performing properly.

Considerable effort was expended to enlist the contractors, their service technicians, and their customers in the program. In addition, customers that do not get annual air conditioner tune-ups were informed of the benefits and encouraged to participate.

Contractors

The contractors are, first of all, interested in the economic viability of their businesses. Market share, revenue per transaction, and profit are their primary motivations. The service call or annual tune-up provides them with the opportunity to achieve an advantage over their competition. In general, service calls and annual tune-ups are not profit makers. However, the annual tune-up is a way for the contractor to maintain contact with their customer base and give their employees work during periods of low demand. The bulk of the contractors profits come from selling replacement parts and from selling a replacement air conditioner when the current unit fails. The system works as it is for the successful contractor. In the absence of a market disruption, they see no need to change it.

The effort to enlist contractors included four mailings, personal visits, and telephone follow-up. Proctor Engineering Group was successful in recruiting 10 contractors out of 54 known Fresno contractors. These ten included all but two of the major residential contractors in the area. The contractors who participated saw the program as a way to differentiate themselves from the

competition and give them an advantage over their competition. Most thought that participation would not necessarily increase referrals but, rather, would give them additional credibility by providing a second opinion confirmation of their recommendations. It was clear from speaking with the contractors and examining the production numbers that the participating contractors would have benefited much more if the program had occurred during their spring tune-up season. Table 5-1 presents the production by contractor by month.

	June	July	August	September	October	TOTAL
Contractor 1	1	0	10	103	0	114
Contractor 2	0	3	1	4	0	8
Contractor 3	0	0	1	36	2	39
Contractor 4	0	0	0	0	0	0
Contractor 5	2	0	1	0	0	3
Contractor 6	1	0	1	0	0	2
Contractor 7	0	0	0	1	0	1
Contractor 8	0	0	0	0	0	0
Contractor 9	7	10	4	31	0	52
Contractor 10	0	2	3	6	0	11
TOTAL	11	15	21	181	2	230

Table 5-1 Contractor Participation by Month

Table 5-1 demonstrates two important points. First, not all contractors trained chose to participate in the program. The contractors attending the training that did not participate cited the fact that they were busy servicing "no cool" and related service calls and did not have time to institute the program.

The second point clearly demonstrated by Table 5-1 is that for those contractors that did participate, the fall tune-up season that began in mid-September allowed them the opportunity to implement the program. During the summer months they were unable to keep up with repairs of air conditioners, much less try to perform tune-ups. However, when they started their fall heating season tune-ups, which normally do not include looking at air conditioners, they had the time to sell the service to the customer. The month of September accounted for 79% of the production in the program. Ninety four percent of the tune-ups performed in September (171 out of 181) were performed in the final two weeks of the month after three of the contractors started their fall maintenance contract service visits.

Two of the participating contractors clearly thought the refrigerant charge and airflow check procedures utilized by the CheckMe![™] software were of value. Both of these contractors incorporated the test procedures into every service visit their technicians perform.

Service Technicians

The service technician's decision of whether or not to participate was for the most part made for them by their company. The service technicians were required to attend the training if their company was participating.

It was obvious in the training that the technicians were sold on the program and thought it was of value. However, several stated that they thought the program was only viable during the spring tune-up season. Their feeling was that it would be hard to implement the program under the pressure of having several "no cool" calls waiting for their arrival. If the technicians believed that the program would be hard to implement under the pressure of their work load, they would be less willing to push the service.

Proctor Engineering Group tried to overcome this barrier by performing field visits with the service technicians. During these visits the PEG representative would demonstrate that running the CheckMe![™] program took little additional time once the air conditioner was running. This approach worked in selling several technicians on implementing CheckMe![™]. These technicians realized that CheckMe![™] was a viable tool even under the strain of heavy "no cool" call loads. There were two technicians in particular that became comfortable enough with CheckMe![™] to incorporate it into their repair visits.

Sixteen of the 50 service technicians trained tried using the CheckMe![™] procedure used the procedure during the project. Three of the contractors (with 11 trained technicians) did not participate in the program after attending the training (one of the three did complete one job).

Two of the contractors (with 15 trained technicians) dropped out of the program right after start up. The larger of the two contractors (10 trained technicians) dropped out after completing only 3 jobs. The reason they gave was that the CheckMe![™] program made their service technician look "foolish and inexperienced". Their technicians did not use the CheckMe![™] software or have the customer call the data in to the toll free number. Rather, they simply filled out the field data form and gave it to the customer. When one customer took it upon themselves to call the data in, about a week after the technician's visit, the data indicated the air conditioner had a problem. This upset the customer which in turn upset the contractor. The contractor dropped out of the program at that point.

Eleven of the remaining 24 service technicians actively participated in the program. The technicians who did not regularly incorporate the CheckMe![™] program into their repair visits become comfortable with it. New procedures are initially more time consuming and CheckMe![™] is no exception.

Customers that regularly get their air conditioners serviced

The effort to enlist customers included two rounds of mailings, media outreach, and direct contractor marketing. This was a continuing process throughout the program.

Those customers that participated did so, for the most part, as a direct result of being informed of the program by the service technician.

The telephone follow up indicated that most customers that have annual service had already had the service performed prior to the program.

Customers that do not regularly get their air conditioners serviced

Customers that do not get annual tune-ups were generally not influenced by the media campaign. However, service technicians were often successful with this group of customers. Once the service technician was at their house to complete a repair call, it was easy for them to convince the customer to participate in the program.

VI. SOFTWARE AND DATA COLLECTION PROTOCOLS

Key to the success of the CheckMe![™] program was having a software that was user friendly. The contractors and service technicians needed a mechanism that did not require them to spend significant amounts of time gathering data. Both the service technician and the customers needed a software that was able to generate a definitive answer concerning the condition of the air conditioner.

Besides the software program there were two "hard copy" procedures or data acquisition forms that were used in the program. The first was the CheckMe![™] Program Data Entry Form. This form was distributed to the contractors and service technicians at the training sessions and was included in the second mailing to the customers. The second form was the RCACS HVAC Inspection Form. This form was used by PEG staff when inspecting the contractors' work.

CheckMe!™ Software

The CheckMe![™] software is a PEG proprietary product that was developed over the course of several years. The CheckMe![™] software is a windows based program that runs on any PC compatible computer with a 486 or higher CPU. The software was issued with a limited usage license. The program is easy to navigate and very concise. The program consists of 9 screens that lead the user through entering all information needed to track customer and service technician participation and air conditioner performance. A copy of the software data entry screens are contained in the appendix.

The software data entry and output includes:

- Customer information
- Contractor and service technician identification
- Air conditioner operating parameters
- Refrigerant change analysis results
- Airflow analysis results
- Final information and additional recommended efficiency measures

Software Operation

The CheckMe![™] software utilizes algorithms that allow it to check system performance based on manufacturers' recommended airflow and charge analysis techniques.

Charge Analysis

The CheckMe![™] software analyzes charge based on superheat or subcooling. These procedures require the following information:

- Refrigerant metering device type
- Outdoor air temperature
- Return air dry bulb and wet bulb temperatures
- Supply air dry bulb temperature
- Refrigerant suction line or liquid line temperature
- Refrigerant system suction or discharge pressures and associated temperatures

Fixed Metering Devices

Most air conditioners have fixed metering devices. When an air conditioner has a fixed metering device, superheat is the method of choice in determining correct charge. For a given set of conditions (temperature and humidity entering the indoor coil and temperature entering the outdoor coil), a correctly charged air conditioner will have a specific superheat. This specific superheat is called the "Target Superheat". The target superheat is available through a chart supplied to each technician at the initial CheckMe![™] training, through the manufacturers' "slide rules", and through calculation. In the CheckMe![™] program the calculation is implemented within the software.

The measured superheat is compared with the Target Superheat. If the measured superheat is more than 5°F higher than the Target Superheat, the unit is undercharged and refrigerant needs to be added. Similarly, if the measured superheat is less than the Target Superheat by more than 5°F, the unit is overcharged and refrigerant needs to be removed. Superheat is a very sensitive indicator of incorrect charge in fixed metering device systems, but the amount of undercharge or overcharge has not been directly related to a given difference between the measured superheat and the Target Superheat. In other words, at this point, an 8°F error in superheat cannot be said to indicate that the refrigerant charge is off by X percent.

Variable Metering Device

When an air conditioner has a variable metering device (TXV), subcooling is the method of choice in determining correct charge. For all conditions, a correctly charged air conditioner will have a specific subcooling. This specific subcooling is called the "Target Subcooling". The Target Subcooling is specific to the individual equipment and is often stamped on the nameplate of the outdoor unit. In the CheckMe!TM program the Target Subcooling is entered into the program by the service technician. The measured subcooling is compared with the Target Subcooling. If the measured subcooling is more than 3°F higher than the Target Subcooling, the unit is overcharged and refrigerant needs to be removed. Similarly, if the measured subcooling is less than the Target Subcooling by more than 3°F, the unit is undercharged and refrigerant needs to be added. Subcooling is an excellent indicator of incorrect charge in TXV systems, but the amount of undercharge or overcharge has not been directly related to a given difference between the measured subcooling and the Target Subcooling. As with fixed metering device systems and at this time, a 5°F error in subcooling cannot be said to indicate that the refrigerant charge is off by Y percent.

Airflow Analysis

The CheckMe![™] software uses a measured temperature split to determine if the airflow is correct. The airflow can only be determined if the charge is first brought into the correct range.

Temperature split is the temperature difference between the supply plenum dry bulb temperature and the return plenum dry bulb temperature. This temperature difference is a strong indicator of the correct operation of the air conditioner. For any given set of conditions (return plenum wet and dry bulb temperature and outside coil inlet temperature), there is an expected temperature split that will occur when the unit is operating properly. The expected temperature split is referred to as the "Target Split". A measured temperature split within 3.5°F of the Target Split is considered acceptable. A measured temperature split outside that range is a strong indication that there is still a problem with the machine. When the temperature split is too large it is an indication of low airflow through the inside coil. When the temperature split is too low it indicates low cooling capacity which can be associated with many different problems including: dirty outside coil, low airflow through the outside coil, compressor problems, contaminated refrigerant, restrictions in lines, orifice problems, and others.

CheckMe!™ Program Data Entry Form

The CheckMe![™] Program Data Entry Form is used by the service technician to record data for entry into the CheckMe![™] program. Besides the customer demographics and contractor information, the form also contains all information necessary to determine charge and airflow characteristics of the air conditioner. Once the service technician completes the Data Entry Form the information is entered into the CheckMe![™] software for analysis. The Data Entry Form is also used by the inspector.

The CheckMe![™] Program Data Entry Form contains:

- Customer information.
- Contractor and service technician identifier information.
- All data necessary to run the CheckMe!™ software, including charge and airflow information.

CheckMe!™ Inspection Form

The CheckMe![™] Inspection Form is a concise one-page form that contains information on the customer and contractor and a series of questions that require simple yes or no answers or the recording of the rating given by the customer. The form also provides space for the inspector to record comments made by both the customer and inspector concerning the job.

The CheckMe!™ Inspection Form contains:

- Information on the original service date, contractor, service technician, and inspector
- Customer information (i.e. name, address, etc.)
- Information on the technician's performance from the customer's perspective
- Customer satisfaction survey for both the technician's performance and the CheckMe!™ program
- Inspector comments on the job

VII. CONTRACTOR RECRUITMENT & TRAINING

In order for the CheckMe![™] program to be successful, local contractors had to buy into participating in the program. In order to accomplish this "buy in", PEG recruited as many contractors as possible. Once contractors had been successfully recruited their service technicians had to be trained to implement the program. This section of the report covers the recruitment and training aspects of the program.

Contractor Recruitment

Air conditioner service contractors in the Fresno/Clovis area were identified through two means. The first was a search of internet accessible business listings, for example: internet yellow pages, business directories, etc. The second was a manual search of the Fresno Pacific Bell yellow pages. A total of 54 air conditioning contractors in the Fresno/Clovis area were identified.

Once contractors were identified, telephone outreach by PEG obtained a contact name within the company and obtained/confirmed the company mailing address. The campaign to recruit contractors included four rounds of mailings, follow up calls, and personal visits.

First, an introductory letter informing the contractors of the program was sent. In this letter the contractors were told about the CheckMe![™] program.

The letter detailed that the CheckMe![™] program would afford them the following benefits:

- An aggressive publicity campaign
- Direct mailings to potential customers along with a referral list containing the name and phone number of their company
- Free promotional literature and free software
- Opportunities for add-on sales
- An improved AC tune-up procedure with little or no additional time spent by the service technicians
- Free technician training
- Toll free support for their service technicians

A second letter was sent that provided greater detail on the program and again invited the contractors to participate.

The third letter, which was originally intended to be the final outreach letter prior to the customer mailings was sent by certified mail. The third letter answered some of the contractors commonly asked questions and again invited the contractor to join the program.

A fourth letter was sent after the first customer mailing was delayed. This letter gave the contractors one last chance to sign up and be included on the contractor referral list that was included in the customer mailing.

Attempts were made to contact all of the contractors by phone to solicit their participation. Whenever possible a personal visit was arranged with a principal of the company and the program was discussed in detail.

Contractor Participation Agreement

The contractors agreeing to participate were sent an agreement that had to be signed prior to their participation in the program. The letter of agreement required the contractor to verify that they:

- Were currently licensed to perform AC service and repairs in the State of California
- Possessed and would maintain specified amounts of insurance
- Agreed to send their service technicians to the required training
- Agreed to allow inspection of their service technicians work and comply with recommendations to correct deficiencies discovered during the inspection process
- Would ensure their service technicians were properly equipped as specified

Contractor and AC Technician Training

Based on the response to the contractor recruitment efforts, 10 contractors agreed to attend a free training provided by PEG. The training was held in a classroom setting and lasted approximately four hours. The training covered program policies and procedures, AC tune-up procedures (charge and airflow), computer program introduction, function, and operation, and contractor and service technician incentives.

The technicians were shown the proper techniques for testing refrigerant charge specific to manufacturers' recommendations for different refrigerant metering devices. The techniques employed included superheat (for non-TXV metering devices) and subcooling (for TXV metering devices). The technicians were also shown the proper techniques for assessing airflow. The training concentrated on how service technicians should perform testing and repair procedures and potential follow up procedures.

Some trainees privately expressed concern about what would happen when the manufacturers' specified charge tests were used along with the appropriate airflow checking technique on systems that their company had installed or previously serviced. Many thought that their old systems would show problems. The most sufficient answer generated was that the software was a new tool never before used on residential systems in Fresno.

The training included a thorough demonstration of the CheckMe![™] software and examples of completion of the appropriate forms. The CheckMe![™] software was run several times with varying scenarios of charge and airflow characteristics. Technician response to the software was very positive.

Each technician was given a written examination at the end of the training. A 70% score was necessary to pass. Each test was graded by the instructor after the training and written feedback was mailed to each technician on any questions that they answered incorrectly.

Each technician successfully completing the training was mailed a letter of congratulations, a completion certificate, the technician toll free number, and answers to any specific questions they had. Additionally the contractors were mailed a letter of congratulations informing them of the personnel within their company that were authorized to participate in the program.

Results

The contractor recruitment effort resulted in 12 contractors agreeing to participate in the program. Two of the 12 contractors decided not to participate after showing initial interest. One of the contractor's non-participation was due to the program's insurance criteria. The second contractor seemed unwilling to accept the inspections of his employees' work. The remaining ten contractors committed to the program and signed participation agreements.

Six training sessions were held in May. A total of 50 service technicians, service managers, and owners attended the training sessions. Table 7-1 details the number of personnel trained per contractor.

Contractor Identifier	Number of Technicians Trained
Cont. 1	8
Cont. 2	4
Cont. 3	66
Cont. 4	4
Cont. 5	10
Cont. 6	5
Cont. 7	2
Cont. 8	5
Cont. 9	1
Cont. 10	5
Total	50

Table 7-1 Number of Personnel Trained by Contractor

All of the technicians received a passing grade on the examination and were certified to work in the program. The average test score for all persons attending the training was 91%.

Feedback was gathered from the contractors by using an evaluation form they completed at the end of the training. The evaluation forms were submitted anonymously to ensure the contractors felt they could be honest in their ratings. Table 7-2 presents the questions and the responses for each.

Table 7-2 Contractor Evaluations of Training Program

As a result of the training you attended today can you:

Completely and accurately fill in the required data entry forms

No	0%
Maybe	6%
Yes w/help	3%
Yes	92%

Assist the customer in understanding the data presented in the data entry forms

No	0%
Maybe	0%
Yes w/help	11%
Yes	89%

Correctly measure wet bulb and dry bulb temperatures

No	0%
Maybe	0%
Yes w/help	3%
Yes	97%

Recognize when the temperature measurements you have gotten are correct or incorrect?

No	0%
Maybe	3%
Yes w/help	6%
Yes	92%

No	0%
Maybe	3%
Yes w/help	14%
Yes	83%

Complete airflow testing using the airflow chart provided in training?

Complete charge checks and adjustments using the superheat or subcooling method?

No	0%
Maybe	0%
Yes w/help	8%
Yes	92%

Rate your overall impression of the training you attended today:

This class was helpful in my job

Not at all	0%
A little bit	17%
Quite a bit	47%
Very	36%

This class was interesting

Not at all	0%
A little bit	14%
Quite a bit	39%
Very	47%

As demonstrated in Table 7-2 the contractors felt the training met the stated objectives and would be helpful in the performance of their jobs.

VIII. TOLL FREE TELEPHONE SUPPORT SERVICES

Toll Free Telephone Support For Customers

Proctor Engineering Group established a toll free telephone line for consumer assistance. The toll free number, 877 – CHECKME, was selected as being both easy to remember and easily associated with the CheckMe![™] program.

The 877 – CHECKME number was fed into a two line phone system. If the first line was busy the call would be rolled over to a second line. The phones were staffed between mid-May and mid-September. The phones were staffed Monday through Friday, from 8:00 AM to 5:30 PM. Automated voice mail was available if the call came in after hours of operation or whenever both lines were busy.

Toll Free Telephone Support For Service Technicians

The AC service technicians were given access to a dedicated toll free line. This line was connected directly to the offices of PEG's Managing Partner and Field Manager. These two individuals are PEG's most experienced personnel in the HVAC training and field implementation area.

This phone line similar to the 877 – CHECKME number, was staffed Monday through Friday, from 8:00 AM to 5:30 PM. Automated voice mail was available if the call came in after hours of operation or if the line was busy.

Additionally, PEG's Field Manager was available to the service technicians through a paging service. All of the service technicians were provided with a pager number to use for the Field Manager if they could not get a response on the toll free support line.

Results

The toll free telephone support proved to be one of the success stories of the program. Service technicians and customers alike appreciated the ease of being able to place a phone call and get the analysis performed for them.

The overwhelming majority of CheckMe![™] runs performed in the program were called in over the toll free lines. The toll free telephone support should be continued in any future programs and be relied on as the primary means of gathering data from the service technicians and customers. This is viewed as the most cost effective strategy for gathering data.

IX. MARKETING CAMPAIGN

Proctor Engineering Group contracted with Staton & Hughes to conduct a marketing campaign to raise awareness of the CheckMe![™] program in the Fresno and Clovis area. The marketing campaign included several approaches and continued throughout the duration of the program. The marketing efforts included:

- Media campaign
- Direct mailing to customers
- Direct software delivery to customers

Additionally, PEG contracted with Skelton & Associates to place follow-up phone calls to the 15,000 households receiving the second mailing.

This section of the report addresses all marketing efforts and the results generated.

Media Campaign

Throughout the media campaign, Staton & Hughes mailed press packets to members of television, radio and print media and handed the packets out to interested parties at the press conferences. The packets contained information regarding the CheckMe![™] program and air conditioner performance. This included a brochure, a printout of the CheckMe![™] demonstration, sample software, a press release, as well as articles on AC efficiency.

Press Conferences

The first press conference for the CheckMe![™] program was held on May 14 at a local air conditioning contractor's business. The press conference consisted of Mr. Proctor demonstrating the CheckMe![™] program before an array of central air conditioners and air conditioning repair equipment. Two television stations covered the press conference.

A second press conference was held on July 23 at the Lafayette Senior Center to perform a free CheckMe![™] tune-up with a technician from a participating contractor. The press conference was attended by reporters from two radio and one television station. The press conference and a brief interview were aired that afternoon on one of the radio stations and broadcast on the television station's Ten O'clock news.

Print Media

Both the Clovis Independent and the Fresno Bee received media packets at the start of the publicity campaign. A personal visit to the Fresno Bee by John after the first press conference, resulted in the consumer reporter writing an article on the CheckMe!TM program and including it in the business section of the May 18 issue. After numerous follow-up calls to the Clovis

Independent an article on the CheckMe![™] program was included in the business section of the July 31 issue.

Radio

Radio coverage was secured for the second press conference from one station. Two other radio stations aired interviews on July 26 and August 19. Both interviews consisted of information regarding the CheckMe! program and how residents could take part in the program.

Television

In addition to trying to generate interest by the local television evening news, Staton and Hughes pitched the CheckMe![™] program to morning and weekend news shows that have guests. In Fresno, there are six shows of this type.

In addition to the evening news stories resulting from the press conference, two morning news interviews occurred. On August 3 and August 20, Mr. Proctor was interviewed by morning news anchors. The interviews focused on the CheckMe![™] program, how residents could take part, and simple things that residents could do to maintain their air conditioner.

Customer Mailing

A direct mail publicity campaign was used to reach as many Fresno/Clovis area households as possible. The aim of the mailings was to inform the public that the program was being implemented in their area.

The first mailing was designed to raise awareness of the customers about the CheckMe![™] program. The first mailing consisted of a professionally designed, fold-out, informational brochure. The brochure was designed to attract the consumer's attention, briefly explain what the CheckMe![™] program was (free second opinion to verify what your AC technician is recommending), what it could do for them (lower energy bills, give them greater comfort) and how they can find out more about CheckMe![™].

The first mailing was sent to a total of 80,000 homeowners in the Fresno/Clovis area. The mailing was delivered in two waves of 40,000 each to allow for phone support and contractor referrals. The customers targeted for the mailing were selected based on home ownership. In other words, all residents of the Fresno/Clovis area who owned a home were targeted. Additionally, the mailing asked the recipients to forward the materials to other interested persons that may have a use for the CheckMe![™] program.

The second mailing included the CheckMe![™] software (contained on two discs), software operating instructions, a letter explaining the benefits of the program, a list of participating contractors, the service technician data form, and a postage paid return mailer (for returning the disc once the data was entered into the program). The details of this mailing are discussed in the following section.

Software Delivery

The CheckMe![™] software was delivered based on contractor and service technician requests and customer requests in response to the first mailing and the media campaign. A blanket mailing

was sent in July to over 15,000 households. Table 9-1 presents the delivery of software over the course of the program.

Table 9-1 Software Delivery

	May	June	July	August
Contractor Request	30	0	98	0
Technician Request	49	0	0	0
Customer Request	85	116	38	28
Targeted Mailing	0	0	15,052	0
Total Delivered	164	116	15,188	28

A number of considerations were taken into account in determining the best mailing targets for the second mailing. First, the mailing needed to target 15,000 residences.. Second, since the mailing contained a computer program, it was advantageous to target customers that would have a home computer. Finally, the list of addresses needed to have accompanying phone numbers so that follow-up phone calls could be made to encourage the customers to take advantage of the program.

Several approaches for identifying the appropriate households to receive the blanket mailing were explored. The original methodology was to target those with a high likelihood of having home computers. The best prospect for customers with access to a computer were the households in the Fresno/Clovis area with America On-line accounts. However, this targeting methodology was eliminated when it was learned that although America On-line was willing to sell their subscriber list they did not allow phone solicitation of those customers. This meant that the follow-up calls would not be able to be made if the America On-line list was used.

After further consideration it was decided that targeting home owners with the highest assessed market value houses would accomplish the goals of both reaching the market segment that was most likely to invest in preventative maintenance for their air conditioner, own a home computer and have telephone numbers available. The mailings took place in two waves of 7,500 each. The waves were designed to allow adequate time after the mailing for the follow-up calls to occur.

Phone Bank Follow-up to Mailing Two

Proctor Engineering Group contracted with Skelton & Associates, of Sacramento to conduct follow-up phone calls to the second mailing. Calls were made during six phoning sessions. The phone sessions of July 30, Aug.1, 2 followed the first wave of the mailing to 7,500 residents, and the sessions of Aug. 5, 6, and 9 followed the second wave of mailing to 7,500 residents.

To ensure that the reminder phone calls were as effective as possible, a detailed phone script was provided to the phone bank for use in making the follow-up calls. Prior to starting the calls, phone bank employees were given an explanation of the CheckMe![™] program and lead through the phone script. In addition, Staton & Hughes and Proctor Engineering representatives were present on the first night of calling to answer questions posed by the phone bank staff.

The goal of each call was to increase participation in the program. In the process it would discover if the household had received the mailing, if they were still planning to have their AC unit checked this year, and if they would allow us to give their name to a participating contractor for a CheckMe![™] tune-up

Phone calls were placed to all 15,052 households that received the mailing. In total there were 4808 respondents. The results were:

- 35% of the respondents reported receiving the second mailing
- 40% did not remember receiving the second mailing
- 25% refused to answer any questions

Respondents with tune-up potential:

- 71% reported that they had already had a tune-up performed earlier in the season
- 3% reported that they were still planning on getting a tune-up

Results

From May through the end of September, Staton & Hughes worked to place feature stories as well as hard news stories in print, on radio and TV. Overall, Staton & Hughes' efforts secured coverage in three of the four television affiliates in the Fresno area, both major newspapers and two of the four news radio stations.

The influence and effectiveness of the media campaign became apparent during the September 30, 1998 focus group meetings in Fresno. One of the purposes of the media campaign was to help introduce a brand new service, the proper tune-up of an air conditioner to manufacturers' specifications on charge and airflow. Several consumer participants mentioned hearing about CheckMe!TM on TV and radio programs and also reading articles in the local newspapers. Although they could not recall specific details about the program, the media exposure did spark their interest. Hearing about the program on radio and TV and reading about it in the newspaper gave it more credibility with the consumers.

The response to the mailings was not as high as had been hoped for or as could be expected with better timing. The mailings were originally intended to go out in March, but the first mailing didn't go out until mid-May. By the time the mailings were sent the AC contractors were done with their spring tune ups.

The response that 71% of the households had already purchased tune-up services earlier in the year indicates that the targeting strategy employed was very successful. The objective of locating households with a tendency to acquire tune-ups was clearly met. This is a strategy that should be employed in future programs.

The number of return mailers was much less than anticipated. It is believed that the software aspect of the project tended to confuse the general consumer. The program works better when called in on the toll free line and assistance provided by trained personnel. Contractors and customer requests for software also indicate that generally, consumers do not use the program on disk.

X. INSTRUMENTS OF EVALUATION

Focus groups

Proctor Engineering Group contracted with Godbe Research and Analysis to provide pre and post program focus groups with both consumers and local contractors and their service technicians.

A focus group is a qualitative research technique that allows for considerable interaction between participants and permits in-depth exploration of specific themes and ideas that arise throughout the course of discussion. Although the technique allows for detailed discussion of relevant issues, the small size of the group and unpredictability of the participant turnout prevent the findings from being statistically representative of the population from which the participants are recruited. However, the ideas, issues, and terminology uncovered in the sessions do provide valuable input for a variety of purposes, including testing support for the CheckMe!TM software program and 877 telephone service among homeowners and service contractors.

At the outset of this project, Proctor Engineering, Staton & Hughes, PG & E and Godbe Research & Analysis collaborated on the research objectives of this project. From these discussions, it was determined to conduct two focus groups with the intent of examining the following:

- Interest in the CheckMe!™ software program and 877 telephone number among homeowners with central air conditioning in Fresno;
- Interest in the CheckMe![™] software program and 877 telephone number among service repair contractors in the Fresno area *and*
- How to market the CheckMe![™] software program and 877 telephone number to potential customers in the Fresno area.

Pre-Program Focus Groups

Two focus groups were conducted on the evening of April 22, 1998. One group was comprised of homeowners with central air conditioning in Fresno, and the second group was comprised of air conditioning service contractors in the Fresno area. The two focus groups were conducted at Nichols Research in Fresno, California.

Findings

Among homeowners, interest in the CheckMe![™] software program and 877 telephone number is determined by a number of factors: cost, ease of use and product reliability. Ideally, consumers would not have to pay for this software but some consumers may be willing to pay a small fee if the disk can be used repeatedly or if the consumer has unlimited telephone service. Moreover, consumers are more willing to pay higher fees if the recommendations from the software produce a cut in their electric bill. Consumers would prefer to receive the software or speak with an

unbiased, objective source rather than involve a service repair contractor in the process of getting 'a second opinion'. If these conditions are met, if the software is easy to use and if the telephone service is reliable, interest in the CheckMe![™] software program and 877 telephone number increases dramatically.

Among contractors, interest in the CheckMe![™] software program and 877 telephone number is determined by profitability, interest in communicating with computer-savvy customers and whether or not the contractor believes his/her customers would be interested in the 'second opinion' programs. There were two distinct groups of participants in the focus group: participants who believed the CheckMe![™] program was a potential threat to profitability because of the time spent explaining the program to customers; and participants who believed in maximizing profits through new marketing strategies. However, with proof of profitability, some of the skeptical contractors may be encouraged to try the CheckMe![™] programs for a trial period.

Marketing the CheckMe![™] software program and the 877 number will be a challenge for two separate reasons: the contractors do not believe consumers are interested in preventative maintenance and consumers do not believe repair service contractors can be trusted to be involved in the CheckMe![™] program.

- To combat these challenges, the CheckMe![™] program needs to prove to contractors that consumers want to work with contractors to get the most out of their air conditioner. Contractors need to believe consumers desire a mutually beneficial relationship (the consumer is more satisfied with their unit and the contractor makes a profit). If contractors believe this about consumers, they will be more likely to incorporate the CheckMe![™] programs into their regular service calls.
- Consumers need to be assured that contractors are involved in the CheckMe![™] process to provide better customer service, to strengthen the relationship between contractor and consumer and to prove to customers that their recommendations are not solely based on the opportunity to make a sale. Consumers are suspicious of the contractor's involvement in the CheckMe![™] programs but may be more likely to use the CheckMe![™] programs if they know the contractor's work will be inspected and if the programs are endorsed by a reputable consumer group in the community.

Post-Program Focus Groups

Two post-program focus groups were conducted on the evening of September 30, 1998. As with the pre-program groups, one group was comprised of homeowners with central air conditioning in Fresno, and the second group was comprised of air conditioning service contractors and service technicians in the Fresno area.

Findings

Overall, the group of homeowners was enthusiastic about the CheckMe![™] program, but slightly concerned with the cost of the service and the ease of running the computer software. The biggest obstacle identified are convincing homeowners to have their air conditioning unit checked on an annual basis. It appears that once the contractor is in the home and ready to check or repair a resident's air conditioner, the homeowner becomes receptive to the CheckMe![™] philosophy and willing to pay the extra service charge. Therefore, the biggest challenge is not necessarily in selling the CheckMe![™] service, but in creating opportunities for contractors and homeowners to interface and communicate on the benefits of the CheckMe![™] program.

The results of this session strongly suggest that contractors present CheckMe![™] as a new tool to provide better quality customer service, not necessarily a new service that is going to cost customers more than they are paying for the annual tune-up. While customers appear willing to pay an extra labor charge for the 15-20 minutes it takes a service technician to complete the CheckMe![™] tune-up, customers do not want to be charged for a service technician taking measurements or other readings on a special CheckMe![™] worksheet if they are collecting these data already.

The success of CheckMe![™] is dependent on the local contractors and their commitment to the program. Without them, the consumers will never know what kinds of tools are available to better service their residential air conditioning unit. At the beginning of this research project, we incorrectly assumed that the CheckMe![™] program could increase demand by distributing marketing material. After having completed the focus group sessions in April and in September, we know now that increasing the supply (i.e. the number of participating contractors) of the product is the most effective way to achieve the goals of the CheckMe![™] program, increase profitability for the participating contractors and better service residential air conditioning customers in California. The mail piece that was distributed to homeowners last spring should be continued, but the focus this year needs to be on convincing potential customers that residential air conditioners need to have an annual tune-up, rather than on the benefits of a CheckMe![™] tune-up. The potential customers who will contact one of the participating contractors will mostly likely be long-term CheckMe![™] customers because they will have been convinced of the benefits of an annual tune-up, rather than short-term customers that are only interested in a second opinion.

The participants in the second focus group session were positive when describing their experiences with the CheckMe![™] program. However, among the owners/managers in the group, there was misperception that a CheckMe![™] tune-up takes too long to perform. The service technicians in the group were able to counter this misperception and clarify the length of time it takes to complete a CheckMe![™] tune-up, especially if the technicians are required by their boss to take the measurements for refrigerant charge and airflow already. Because of this common misperception among the owners/managers of the contracting businesses, we recommend addressing this issue early on in the recruitment period. Perhaps offering some of the participating service technician's names and phone numbers as references would demonstrate good faith on the part of the CheckMe![™] program and encourage owners/managers to consider participating in the coming year.

The timing of the program is certainly key. We believe if the program can be operational by early Spring, there will be a new group of contractors that is willing and enthusiastic about participating, in addition to the continued support from the current participating contractors.

Full details of both the pre and post program focus groups are presented in the appendix.

Surveys

Pre-Program Surveys

Proctor Engineering Group conducted a survey called the "RCACS Contractor pre-participation survey". The survey was conducted over the phone, during the month of June 1998. The survey contact list was based on a list of 53 AC contractors in the Fresno and Clovis area. Twenty nine of the contractors (55%) were reached by phone. Twelve of the 53 contractors (23%) failed to act on requests to call the survey taker back at a later time. Thirteen of the 53 contractors (25%) use

answering machines or voice mail during business hours and no message was left after 2 attempts to reach a person.

Of the 29 contractors contacted, 20 of them agreed to participate in the survey.

The twenty contractors participating in the survey provided the following self reported estimates:

- They performed a total of 17,700 checkups a year.
- They represent a combined total of 118% of the residential market.
- Ninety three percent of the respondents thought a media campaign would be beneficial to their business.
- On average, 30% of their residential business is tune-ups.

Post-Program Surveys

During the period of September 11 through 22 Staton & Hughes placed three rounds of phone calls to 55 air conditioning contractors in the Fresno and Clovis area to do a follow up survey on the CheckMe![™] program. All of the contractors had originally been approached in late spring to participate in the CheckMe![™] program. Of the 55 contractors seven were either under the ownership of another contractor or had gone bankrupt. Therefore the percentages and figures presented are compiled from a field of 48 eligible contractors.

Staton & Hughes were able to contact 18 (38%) of the contractors by phone. Each of the contractors was asked a series of questions to get their impressions of the CheckMe!™ program.

Participating Contractors

Six of the eighteen contractors participating in the survey participated in the CheckMe![™] program. Each of the contractors was asked if they felt they had benefited from the CheckMe![™] program. Three of the six contractors reported that they felt they had benefited from their involvement. Of the three reporting that they felt they had not benefited from their involvement, two cited the limited number of referrals that came from the marketing program. Those referrals they did receive did not result in many service calls.

The other participant said they believed their involvement actually hurt their business because the CheckMe![™] program made their service technician look "foolish and inexperienced". It should be noted that this contractor only did a few CheckMe![™] runs and their technicians did not follow the procedures outlined in the training.

Non-Participating Contractors

Of the 12 contractors taking part in the survey that did not participate in the CheckMe!™ program:

- Four contractors said that they did not participate because the program started too late in the season or they were too busy.
- Three contractors said that the program did not cater to their market (mainly commercial).

- One contractor was a small one person business and he did not see any benefit to participating.
- One contractor reported that their technicians felt the program might be too bureaucratic.
- One contractor was interested in the program but he had health difficulties and was not able to participate.

All of the contractors, both participating and non-participating, were asked to provide feedback on how the program could be made better. Eleven of the contractors had no suggestions. All seven of the contractors that provided suggestions indicated that if the program were offered during the late part of the winter or early spring, they would have either benefited more (for those that participated) or would have been more inclined to participate (for those that didn't participate) since that is the time of year when they do the majority of the annual tune-ups and maintenance work. Five of the contractors commented that the summer months (when the program happened) are their busy months when they are doing more repair work than maintenance work.

Field Data (Software data)

The field data gathered in the CheckMe![™] program is contained in the program database. The CheckMe![™] software automatically stores the data gathered by the service technician as it is entered into the program.

There were two primary means of getting the data. The first, and by far the most popular, was the use of the toll free phone system. Service technicians or the customers could call in the data recorded by the service technician on the CheckMe!TM Program Data Entry Form. The data was then entered into the software program by a PEG representative, and the results were relayed immediately to the service technician or customer. This allowed the customer to make an on the spot decision about potential repairs. The second option was for the customers to run the CheckMe!TM software on their home computer and return the diskette containing the data in a postage paid mailer that accompanied the software. This second option was rarely used.

A total of 264 CheckMe![™] software runs were completed for service work on 231 air conditioners.

The version of CheckMe![™] software used in this pilot did not require the service technicians to supply both pre and post repair data so not all systems got pre and post repair data recorded. Most service technicians used the software as a second opinion mechanism to convince the customer that the system was either in need of repair or running as intended by the manufacturer.

The CheckMe![™] software has two levels of built in error checking. At level one, invalid data is rejected. The software will not progress until the errors are corrected. At level two, the software alerts the user of data that might be in error but will allow continuation at the users command. Sixty two of the 264 CheckMe![™] runs generated alerts warning that at least one of the numbers might be in error.

General Information

Eighteen of the 231 systems (8%) had a TXV refrigerant metering device. TXVs are typically only found on high efficiency equipment (SEER 12 or higher). It is reasonable to assume that the remainder of the systems were standard efficiency equipment of SEER 10 or less.

One of the data points gathered by the CheckMe![™] software was whether the contractor performing the service was the customers regular contractor, a new contractor based on the CheckMe![™] program referral list of eligible contractors, or neither of these. As shown in Table 10-1 the majority of the customers used their regular service contractor.

Table 10-1 Contractor Selection Response

Regular Contractor	175
New Contractor From the CheckMe!™ Program List	83
Neither of These	6

The high number of customers using their regular service contractor is due to the fact that the majority of tune-ups done in the program were done after the contractors started their fall tuneup service visits. Ninety four percent of the tune-ups performed in September (171 out of 181) were performed in the final two weeks of the month after three of the contractors started their fall maintenance contract service visits. The response of "A New Contractor from the CheckMe!TM Program List" may be inflated since this was the default answer in the software.

The customers were also asked the reason for the service technician's visit. Table 10-2 shows that the majority of customers participating did so as part of a routine service visit.

Table 10-2 Reason for Service Visit

Routine Visit	155
Response to the CheckMe!™ Program	94
Problem with Air Conditioner	6
Other	9

Again this is due to the large number of customers that participated when the contractor visited their house to perform their fall tune-up service. The answer of "Response to the CheckMe![™] Program" may be inflated since this was the default answer in the software. Only six customers participated when the contractor was at the house to deal with a problem with the air conditioner. The data in Table 10-2 again point to the importance of integrating CheckMe![™] into the routine visit.

Charge

Manufacturers of residential air conditioning systems recommend various methodologies for determining proper charge. The most common method for air conditioners with fixed metering devices (cap tube and orifice) is evaporator superheat. For systems with Thermostatic Expansion

Valves (TXV) the subcooling method is most often suggested. These are the methodologies that are incorporated into CheckMe!TM. Ninety two percent of the systems were fixed orifice, only 18 of the systems serviced in the program had TXVs.

The analysis performed by PEG looked at the data from all 264 CheckMe![™] software runs. Twenty seven systems got more than one run of the CheckMe![™] software. On these systems the service technician called in the data, found that there was a problem with the system, performed repairs and called in a second set of data. Seventeen of the 27 systems receiving multiple runs of the CheckMe![™] software finished with the correct amount of refrigerant charge and airflow.

The service technicians reported whether there was a change in the refrigerant charge on the CheckMe![™] Program Data Entry Form. Table 10-3 gives the results of the answers provided by the service technicians.

No Change	205
Refrigerant Added	38
Refrigerant Removed	21

Table 10-3 Refrigerant Charge Adjustment

The large number of systems reported as having no change in refrigerant charge in Table 10-3 indicates that the service technicians were more prone to call in the data on the system as found on their first tests. Since the service technicians were not required to report the final condition of the system, many of the results in the database only reflect the initial condition. The service technician would then use this information to inform the customer of the work that needed to be performed and close the sale. The results presented in Table 10-3 may not accurately represent the amount of refrigerant charge adjustments that were made.

The state of refrigerant charge in the air conditioner was determined based on either superheat (for non-TXV systems) or subcooling (for TXV systems). Table 10-4 presents the results of the analysis of charge condition.

Table 10-4 Charge Condition

Correct Charge	146	55%
Undercharged	63	24%
Overcharged	41	16%
Not Calculated	14	5%

The percentage of units with correct charge is higher than would be found in a sampling that includes only initial tests and no post-repair data. In a previous study in the Fresno area, PEG found that approximately one third of the systems would be correctly charged, one third undercharged and one third overcharged.

The systems listed as not calculated are those systems that were tested under conditions where superheat is not a precision method. The superheat methodology was developed for conditions that exist in the more humid parts of the United States. Under some conditions superheat cannot

be used to accurately "dial in" the charge. Problematic test conditions include hot dry climates that experience low indoor wet bulb temperatures in combination with high outdoor dry bulb temperatures, like Fresno.

This problem is illustrated by the superheat charging chart shown in Figure 10-1. The superheat charging method consists of running the air conditioner long enough to reach steady state, then testing the superheat, indoor wet bulb temperature, and outdoor dry bulb temperature.



WET BULB SUPERHEAT CHART

Figure 10-1 Superheat Charging Chart

For a given indoor wet bulb temperature and a given outdoor temperature, the target superheat can be read off the chart. For example, if the indoor wet bulb temperature is 68°F and the outdoor temperature is 85°F the target superheat can be determined by following the diagonal line marked 68°F to the vertical line marked 85°F. Moving straight to the left from that intersection point the target superheat can be read as 19°F.

Sometimes however, the indoor wet bulb temperature is too low to allow use of superheat as an absolute measure of charge. For example, in Fresno the indoor wet bulb temperature can be as

low as 58°F. By following the 58°F line(the lowest diagonal line) on Figure 10-1 it is apparent that the outside temperature cannot exceed 82°F for superheat to still be a precision procedure.

As expected, conditions were encountered where the target superheat was less than 5°F and superheat could not produce precision charge adjustments. As shown in Table 10-4 this happened 5% of the time. It is most likely to happen in the summer when the outdoor temperatures are high. Under these conditions the customer will have been using the air conditioner, depressing the indoor wet bulb temperature. The data indicate that the average outdoor temperature was 99°F for the 14 tests where the superheat target was less than 5°F. This indicates that the optimal time for implementation is during the spring before the outdoor temperatures get too hot.

Leaks

The CheckMe![™] procedure suggests technicians check for refrigerant leaks whenever they find a system that is undercharged, but does not require leak checking. The Environmental Protection Agency has established guidelines for when refrigerant leaks must be checked. The EPA guidelines do not require leak checks on residential systems.

The service technicians reported only 14 leaks on the 231 systems examined. Based on previous experience this number may be low. It is suspected that service technicians are hesitant to change their current leak testing procedure to include checking for leaks on all undercharged systems. Leak testing can be time consuming. Unless the leak is located at the service access port, the repair requires removal of all refrigerant, repair of the leak, and re-charging the system. Technicians have learned that customers are generally unwilling to take on this expense; so they ignore the problem. The service technicians reported that 6 leaks were repaired. It's very likely that all 6 of these leaks were located at the service access port so removal of the refrigerant was not required and the cost of the repair was minimal.

Airflow

The CheckMe![™] procedure checks airflow through the evaporator coil by using the temperature split method.

Temperature split is the temperature difference between the supply plenum dry bulb temperature and the return plenum dry bulb temperature. This temperature difference is a strong indicator of the correct operation of the air conditioner. For any given set of conditions (return plenum wet and dry bulb temperature and outside coil inlet temperature) there is an expected temperature split that will occur when the unit is operating properly. The expected temperature split is referred to as the "Target Split". A measured temperature split within 3.5°F of the Target Split is considered acceptable. A measured temperature split outside that range is a strong indication that there is still a problem with the air conditioner. When the temperature split is too large it is an indication of low airflow through the evaporator coil. When the temperature split is too low it indicates low cooling capacity which can be associated with many different problems including: dirty outside coil, low airflow through the outside coil, compressor problems, contaminated refrigerant, restrictions in lines, orifice problems, and others.

Table 10-5 presents the results of the temperature split testing performed in the program.

Table 10-5 Temperature Split Test Results

Correct Temperature Split	118	45%
Low Airflow	32	12%
Other Problem	9	3%
Not Calculated	105	40%

The percentage of units with correct temperature split is higher than would be found in a sampling that includes only initial tests and not post repair data. The systems listed as not calculated are those systems that were not analyzed due to the refrigerant charge being incorrect. The temperature split method assumes that the charge is correct. If the charge was known to be incorrect the CheckMe![™] software indicated that the charge needed to be corrected and the temperature split analysis was not performed. It is likely that many of the systems with incorrect charge that did not have the temperature split analyzed would show up as having low airflow.

Inspections

One goal of the inspection process was to allow the CheckMe![™] program to verify the accuracy of the data being reported by the contractors. When the data are accurate, the process can be under control without large expenditures. Accurate data make it possible to give good feedback to the technicians based on the data analysis alone. Feedback helps improve the competence and confidence of the technicians.

Another goal of the inspections was to allow the CheckMe![™] program to provide the technicians with both verbal and written feedback on their job performance based on observation. By getting feedback on the work completed, the technicians learned from other expert observations. The feedback can provide both positive reinforcement of the work performed correctly and correction of mistakes so that they could be avoided in the future.

On-site Inspections

There were two types of on-site inspections used in the program. The first was a ride along inspection, where the inspector would accompany the service technician at the time of the tuneup. These allowed the opportunity to not only observe the work performed by the service technician but also allowed for immediate feedback and additional training. The second type of inspection was the post tune-up inspection. These inspections consisted of the inspector visiting the customer's house after the tune-up had already been completed.

The on-site inspection consisted of a customer interview and performance of the testing called for in the CheckMe![™] software. For post-inspection visits the inspector would perform the testing. For service technician ride-along inspections the service technician would perform the testing while observed by the PEG inspector.

Number of Inspections Completed

The CheckMe!™ program completed tune-ups on a total of 230 air conditioners at 225 residences. During the course of the program PEG completed a total of 22 inspections, or 10% of the

completed jobs. Forty five percent of the completed inspections were post-treatment inspections. Fifty five percent of the completed inspections were ride-along inspections. Table 10-6 details the inspections completed. Table 10-6 presents the service technicians' percentage of completed jobs within the program and the percentage of inspections completed by service technician.

Technician	% of Total CheckMe!™ Tune-ups	% of Total Inspections
ZB01	27%	18%
DB01	23%	23%
KL01	17%	18%
RM01	17%	14%
JL01	6%	0%
AP01	3%	14%
All Others	7%	13%

Table 10-6 Inspections Completed by Technician

As shown in Table 10-6 PEG targeted inspections for the service technicians performing the highest number of CheckMe![™] tune-ups. The percentage of overall inspections by technician was closely matched to the percentage of their production within the program. One technician (JL01) who performed a significant amount of CheckMe![™] tune-ups but did not have any inspections of his work. This technician performed CheckMe![™] tune-ups only during the final two weeks of the program and PEG was not able to arrange a time to either meet up with him for a ride-along inspection or get customers to schedule post inspection visits.

Results of Post-Treatment Inspections

Refrigerant charge condition

Ninety percent of the jobs inspected on post treatment inspections had charge characteristics in agreement with the data reported by the service technician. Forty percent of the jobs still had undercharge or over charge conditions. In these cases, the service technician had correctly diagnosed the condition, but the customer decided not to have the charge corrected. The most common reason was either that the customer did not want to spend the money to get the system fixed, or they were happy with the way the air conditioner was performing and they didn't want to change it.

One job had a discrepancy between the charge characteristics reported by the service technician and the condition measured by the inspector. On this job the service technician had reported that the air conditioner was overcharged but, the inspector found the system to be undercharged. The inspector noticed that the condenser unit was designed so that the access panel to the refrigerant connections allowed large volumes of air to bypass the condenser coil. If the access panel is left off during the service visit, the normal amount of air would not be drawn through the condenser coil. This would result in refrigerant system operation that would not accurately reflect the charge conditions.

The inspector met with the service technician to discuss the job and found out that the access panel had indeed been left off during the service visit. The inspector discussed the importance of the panel being in place and explained the consequences of leaving it off to the technician. The service technician said that he had never thought about it and agreed that he needed to ensure the panels were in place before diagnosing the systems charge.

Airflow Condition

All of the post treatment inspections indicated that the technician had accurately measured and reported the airflow. The airflow characteristics of half of the jobs could not be determined because of incorrect refrigerant charge at the time of the inspection. In order to accurately check airflow, the refrigerant charge must be correct. The airflow characteristics were not determined for the customers that chose not to correct the refrigerant charge.

Thirty percent of the post treatment inspection jobs had low airflow indications during the initial check by the service technician. All of these, but one, had the airflow corrected by the service technician. The most common fixes employed were cleaning the evaporator coil, cleaning the blower, or increasing the blower speed.

One of the air conditioners had low airflow that was not corrected by the service technician. Both the service technician's and the inspector's measurements indicated that the airflow through the evaporator coil was low. The service technician did not clean the coil or take other steps to improve the airflow. The inspector from PEG discussed the job with the technician. Even though the CheckMe![™] software had indicated that the airflow was low, the service technician decided that it was not bad enough to warrant any repairs.

The inspector discussed the efficiency impact of the low airflow with the service technician and got the technician to agree to correct airflow on any future jobs that had low airflow. The service technician stated that he had never really paid much attention to airflow before becoming involved in the CheckMe![™] program and really hadn't realized how adversely low airflow affects the performance of an air conditioner.

Results of Ride-along Inspections

Adequacy of Equipment and Testing Techniques

One of the reasons for the ride-along inspections was to observe the service technicians performing the tune-up to make sure they were performing the service correctly. Key to being able to service the units correctly is having the right tools and equipment. All of the technicians receiving a ride-along inspection had the proper equipment to perform the CheckMe![™] tune-up. The majority of the technicians had purchased new equipment as a result of their involvement with the CheckMe![™] program. The most common purchase was the addition of a more accurate digital thermometer and thermocouple pairing for checking temperatures.

A digital thermometer used in conjunction with a thermocouple provides a more accurate temperature reading than the typical pocket thermometer used by most service technicians. The service technicians remarked that they could not get accurate readings with their old equipment so they had to purchase new equipment. None of the service technicians regretted having to buy

the new equipment. Most remarked that it made the service they were performing better since they were now getting accurate numbers. Other equipment purchases spurred by the training attended in the CheckMe![™] program included four port manifolds for accessing and charging the refrigerant system and electronic scales for weighing refrigerant taken out of or added to the air conditioner.

All of the technicians receiving a ride-along inspection visit correctly performed the testing needed to gather the data required by the CheckMe![™] program. There were no instances of service technicians taking temperatures in the wrong locations or at the wrong time. The training provided had been effective in familiarizing them with the requirements of the program.

Observations and Actions Taken

Charge

During the ride-along inspections the inspector was able to observe the testing procedures and charge correction procedures employed by the service technicians. All of the technicians used the proper procedures for both evaluating and correcting charge.

Table 10-7 presents the initial charge conditions for the twelve air conditioners examined on the ride-along inspections.

Correct Charge		25%
Undercharged		42%
Overcharged		25%
Couldn't Determine		8%
	Total	100%

Table 10-7. Charge Condition

Twenty five percent of the systems examined on ride-along inspections had correct refrigerant charge on the initial test. Forty two percent of the air conditioners were undercharged in the initial test. Twenty five percent of the air conditioners were overcharged in the initial test. Eight percent of the air conditioners could not have the charge characteristics determined because the temperatures present in the house and outdoors made using superheat imprecise. For example, if the outdoor temperature is 100°F and the indoor wet bulb temperature is below 65°F superheat can not be used to precisely determine charge.

Airflow

The final airflows on all ride-along inspection units were in the proper range. Two of the systems initially had low airflow that needed correction. In one case the evaporator coil was completely clogged. The unit was over twenty years old and did not have a filter. The coil was cleaned with coil cleaner and blown out with compressed air. The other unit had a dirty electronic air cleaner that was removed and cleaned. Both of these units had correct airflow after the repairs were made.

A common repair made during the ride-along inspections was to correct the airflow through the condenser coil. The PEG inspector noticed that the service technicians didn't pay much attention to the condition of the condenser coil. The coils were generally dirty and the inspector worked with the service technicians to understand the importance of cleaning these coils and ensuring that they were thoroughly cleaned.

Customer Interaction

The inspector's observation of the service technician interaction with the customer clearly demonstrated the service technicians comfort with the CheckMe![™] program. The service technicians were comfortable with the requirements of the CheckMe![™] program and did a good job of explaining the program to the customers. Generally the service technician would explain what they had found during their tests, present the data to the customer and have the customer call the data into the toll free CheckMe![™] number. The service technician would then explain the customers options for getting any necessary repairs.

Customer Feedback

The inspection process included an in-depth customer interview. The purpose of the interview was to determine the customers' level of satisfaction with both the service technician and the CheckMe![™] program. The customers were asked to answer the following questions with a yes or no reply:

- Did the technician arrive on time?
- Did the Tech fill-out the CheckMe![™] data entry form and give it to the customer?

The customers were also asked to rate their response to the following questions on a scale of 1 to 5 with 5=Excellent; 4=Very Good; 3=Good; 2=Fair; 1=Poor.

- Did the Tech clean-up the job site?
- Overall satisfaction with the CheckMe![™] program?

The customers were also asked to provide comments on their experience with both the service technicians/contractors and the CheckMe![™] program.

Inspections found a very high level of customer satisfaction. The ratings were mostly 5 on a 5 point scale (all the ratings were 4 or above).

Table 10-8 presents the results of the first two questions in the customer satisfaction survey.

Table 10-8 Customer Satisfaction Survey Results

Question	Yes	No
Did the technician arrive on time?	90%	10%
Did the Tech fill-out the CheckMe!™ data entry form and give it to the customer?	94%	6%

Table 10-9 presents the results of the last two questions in the customer satisfaction survey. Only two of the customers gave a rating of less than 5. Both of those were ratings of 4 for the overall satisfaction with the CheckMe![™] program.

Table 10-9 Customer Satisfaction Survey Results

Question	Rating (Avg.)
Did the Tech clean-up the job site?	5.0
Overall satisfaction with the CheckMe!™ program?	4.9

A sampling of the inspected customers' comments about the CheckMe!™ program included:

"I heard about the CheckMe![™] program on the Channel 24 News. I've told several people about the CheckMe![™] program".

"I have told several people about the program."

"I like the program. I used it as a second opinion after a previous contractor told me I needed \$500 worth of work. I will get the unit fixed using CheckMe!TM."

"I like the referral list. Last year a contractor came out and told me I needed a new unit. I referred a couple of friends to the program."

"Couldn't get any better, very impressed with the program as a whole."

XI. RESULTS

Observed Changes in Market Effects

There were a number market effects hypothesized for this program. Many of these are explained in detail in Appendix B (the original analysis and proposal).

Primary Hypothesis -- The program will result in improved diagnosis and repair of charge and air flow

Primary among the market effects is a hypothesized change in how tune-ups are done with the software as opposed to the "common method". There is good evidence to support that this project changed how participating technicians checked and tuned the air conditioner. This is evident in the post-program technician focus group that participating technicians changed their behavior. The following are some examples from technicians:

"I was surprised to find charge wrong on units I have serviced over the years. I even have found 8 ounces overcharge on brand new units."

"I did it for education. I loved it. I don't see anyone really checking charge right, most technicians only do a touch method."

"Most of those units are overcharged new --- 8 out of 10 are overcharged."

"If you do it every time you have covered the bases. It has opened a whole new thing for me."

"You learn how to be more precise."

These changes were also observed on the ride-along inspections of technicians work. These changes are beginning to be institutionalized. It was observed that the technicians had new equipment to properly check charge and air flow.

Sustainability

The primary question is whether these changes will be long term. There is some evidence that they have long term potential. Some examples from technicians and contractors:

Service Manager: "We are going to take this on no matter who is promoting it. It is our responsibility to do the job correctly."

Technician: "I don't want to say it is fun exactly, but it is the right way to do it. I am going to do it on every one."

Technician: "In all actuality it will make you money - call the numbers in and you will make a sale (selling the actual repairs to the unit)."

Technician: "I am really trying to get all the technicians to do it."

Technician: "CheckMe!™ is accurate and we don't have any call backs."

Technician: "If you do the CheckMe!", the on the spot second opinion makes it so you pretty much have the sale on the repairs."

Service Manager: "It's a great tool that will help us. It is something that should be done by everyone, no matter what."

In addition, one major contractor made institutional changes that will support sustainability of the switch to proper diagnostic procedures. That contractor added the measurements to their service sheet.

While the focus group responses and contractor actions show both attitudes and motivations that could lead to long term adoption of an improved tune-up, they certainly do not prove that such a transformation has taken place. It is Proctor Engineering Group's opinion that without at least one full year of implementation there will not be enough local experience to sustain the change.

Contractor: "It needs to be a year or more."

Contractor: "It should be a three or four year program"

Hypothesis -- Reduced Market Barrier - "it takes too long"

One major barrier to adoption of the improved system is that technicians and contractors perceive that a proper diagnosis will take too long. The sustainability at the contractor level is dependent on how many technicians and contractors get over their initial fears. It was clear that the time perception barrier can be overcome. At the final focus group, the technicians and contractors were at different stages of adopting the proper diagnostic process. The responses showed a cross-section of the technician population at various stages of transformation. The technicians with the least experience with the system still thought it added significant time to the job. The technicians with more experience were both faster and had found how to sell the additional repair time suggested by the diagnosis. On the other hand, the service manager with 36 addresses has not yet integrated it into his system.

Technician #1 (60 addresses with the system)

"It was a lot easier than it sounded."

"The only additional time I see is just the telephone call."

"In all actuality it will make you money - call the numbers in and you will make a sale (selling the actual repairs to the unit)."

Technician #2 (52 addresses)

"It was a simple procedure."

"If you do the CheckMe![™]; the on the spot second opinion makes it so you pretty much have the sale on the repairs."

Technician #3 (36 addresses) (Service Manager)

"If you have no problems CheckMe!TM takes 20 minutes - realistically 30 minutes."

Hypothesis -- Reduced Market Barrier - "there is no benefit"

It was hypothesized that experience with the program would show the contractors that there was benefit (revenue potential, cost reduction, and hassle reduction) in adopting the process.

The sustainability is dependent on the contractors' perception of a benefit to using the system. The contractors with the most CheckMe![™] runs have expressed new appreciation for the process and found tangible benefits. Comments from the final focus group confirm this:

Contractor: "It bailed us out on a couple of jobs where we were battling with equipment (and the customer). CheckMe![™] backed me up 100%. Having an independent party do that is great."

Contractor: "CheckMe!™ has generated more revenue for me."

Contractor: "With the system our younger technicians can get right in there and do a good job. That is a real advantage."

Contractor: "We haven't had any callbacks on CheckMe!™ jobs."

Contractor: "It is the right way to do any service."

Service Manager: "You can show pass or fail; it will give you credibility."

Service Manager: "On the job today it reaffirmed that we are a legitimate contractor"

Hypothesis -- Target and Timing -- Customers who get annual tune-ups

It was hypothesized that the primary target for the project should be customers who get annual checkups. Timing is extremely important in this market interaction. Contractors do their initial checkups (also called preventative maintenance or PM) early in the year. This avoids the rush period when it is hot and repairs are the only focus. Early in the year, contractors who want to distinguish themselves are willing to try a new process with their regular customers. In that time, the time and effort ("information costs") of finding out how this will really work are reasonable. In the early period, they also have the opportunity to institute new organizational practices, spend time on training, and observe the results. This project missed that opportunity. In spite of that a number of the contractors are still interested in pursuing this project further.

Service Manager: "We could have done a lot more if it were done earlier."

Contractor: "It would have been real nice during the spring, but they brought it in during the repair season. It is a service, it needs to be in the service season."

Contractor: "March, April, May should be when the program is running."

Contractor: "It needs to happen year round."

Hypothesis -- Reduced Market Barrier -- "media campaign will increase overall demand"

A secondary target was customers who do not usually have their air conditioners serviced every year. It was hypothesized that a media blitz would induce individuals to have their air conditioners checked.

There are indications in the focus group that the media blitz was noticed and raised questions for some consumers, for example:

Technician: I did one today where the customer got the literature and I was going out to do a heater call. He says: You know, I got this thing. What is that?...He was all excited about it. So he got the information but never decided to act upon it.

When the Focus Group Moderator asked: "Did any of your regular customers ask you about the Check Me service?" five respondents answered affirmatively.

The participant data base showed some responses that indicated that the contractor was chosen because they were a CheckMe![™] contractor. Nevertheless the increase in checkups due to the media campaign appears to be minimal. The focus group contractors saw no particular advantage to referrals as bringing them new business.

I don't see much value in the referrals that they would give us or ever will give us. I place pretty much zero value in that.

I did not do one referral and I kind of know why. I don't run the office but they couldn't get hold of the referrals. So they just gave up.

There is no known evidence that the total number of checkups in Fresno increased significantly over this summer.

Hypothesis -- "customers will use the toll free number to obtain information on how their AC is running"

The toll free access to a central location with a human interface to the computer program was originally envisioned as a backup. It was considered secondary to use on the customer's or the technician's PC at the site. This method ended up being the primary method of use and it drew an appreciative response.

You say: "If you like, I can call these numbers in for you right now and you can find out in sixty seconds or less if your air conditioner is in top shape." And they are eager to know. They say "Oh 60 seconds," you know, they're bringing you the phone! They want to know right now before you leave if everything is running in top shape

I like to go back where the customer was. I'd say, well you call, it's your house, it's your phone, call in, it's your unit. They would call. They were instantly involved in the call. They paid more attention right away.

The data support that the toll free call is a viable method of operation.

Hypothesis -- "enthusiastic technicians will sell the improved service to their customers"

It was hypothesized that technicians would be an important avenue of selling the improved service. Almost without exception, the CheckMe![™] runs that were done were sold to the customer by an enthusiastic technician. Technicians found it very effective in getting the equipment to perform properly for two reasons: first, they found that they could diagnose

problems that had previously slipped by them, and second, they found that the necessary repairs were easier to sell if the computerized diagnostic was used.

Hypothesis -- "offering the software for free will increase participation"

Offering the software for free and the phoned in reports for free was expected to increase participation in the program. The data do not support that hypothesis. In fact the free offer confused customers who thought that the entire checkup would be free. It was a mistake to tout free in the literature.

Hypothesis -- "flooding the market place with software will result in use by individual homeowners on their PCs"

This hypothesis known colloquially as the "AOL Model" was one of the marketing methods in the project. Very few individuals used the software on their home PCs. The data do not support this hypothesis.

Hypothesis -- "building trust between the technician and the customer is key to market implementation"

Trust is the cornerstone of a positive interaction between the contractor and the consumer. For contractors who used the system the most, performance uncertainties associated with trust were reduced or eliminated. Customers responded favorably to the new service. Simultaneously the consumer was more comfortable with the interchange because the contractor was using this high tech independent third party method of getting the air conditioner tuned properly. While many customers did not understand the technical side of the checkup, they liked the additional information and openness of the technician in providing the information. The benefits of a proper tune-up were no longer hidden. The process reduced the barrier of asymmetric information. Some focus group comments:

Technician: The customer loved having a third party second opinion immediately available to them.

Technician: First time customers love it.

Contractor: Regular customers asked me about the CheckMe!™ service.

Technician: People liked it because it was a computer and people believe computers.

Technician: I would much rather be dealing with my own customers because we have a relationship that is developed. We know them, they know us. Because they have called us back, they already have trust in us and faith in us, and I think it is a great tool that we could use to improve.

Projected long term impact from widespread adoption of effective AC tuneups

National studies have identified that most existing air conditioners are operating with either a charge problem, and air flow problem, or both. These are the problems that CheckMe![™] addresses. Efficiency is adversely affected if the charge is incorrect by more than 5%. Studies have shown that this exists in over 60% of the air conditioners. Low air flow also reduces efficiency and comfort. Low air flow (less than 350 cfm per ton) has been found in over 70% of the units in the

studies. Overall, the average achievable savings from correcting these conditions is between 12% and 31%. Note that these are program wide savings where units that are already correct (no savings) are averaged into the calculation.

XII. CONCLUSIONS AND RECOMMENDATIONS

The CheckMe![™] program was successful in demonstrating some workable solutions to the current problem with residential air conditioners. At the same time, it identified some methods and tactics that appear ineffective.

Conclusions

- The CheckMe![™] computer program, in combination with training, education, and contractor support can result in a sustainable transformation of the air conditioner service market.
- The keystone to the interaction between the service technician and the consumer is trust. Any project targeted at this interaction must build the consumer's trust in the technician. Otherwise, it will be rejected by the contractor.
- The program was successful in reintroducing the manufacturers' specified refrigerant and airflow tests to the service technicians and got them to use these diagnostic procedures.
- Program timing is critical in gaining both contractor and consumer buy-in for the program. The program must be launched in time to intervene in the seasonal tune-up cycle (February, March, and April).
- The "America On-line model" of sending the software to all households was not successful in stimulating customer participation.
- The toll free telephone support was widely accepted by both service technicians and customers.
- While many customers did not understand the technical side of the checkup, they liked the additional information and openness of the technician in providing the information. The benefits of a proper tune-up were no longer hidden.
- A significant number of high volume residential HVAC contractors are interested in the program. These contractors see benefits of reduced call-backs, improved technician performance, reduced training failures, help with difficult customers, higher sales, and reinforcement of their legitimacy.
- It is clear that the service technician is the key to selling an improved checkup. They are the most effective sales method.
- Targeting by higher assessed home value was highly successful in finding customers who regularly have air conditioner checkups.

Recommendations

Proctor Engineering Group recommends that future applications:

- begin program implementation early in the year (February, March). Contractors be recruited trained and ready to implement the program during their Spring tune-up season.
- focus program marketing on supporting the contractor. It be kept simple, explaining the benefits of the program.
- access the CheckMe![™] expert system primarily through the toll free access line.
- emphasize field training for service technicians.

All appendices intentionally removed