Commercial HVAC Advanced Diagnostics Programs

ACEEE Market Symposium

March 20, 2006

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Advanced Diagnostics

- **“Advanced Tune-Up”**
  - Goes beyond routine checks and changing filters
- **Primary focus is on refrigerate charge and air flow adjustments**
  - Several tools available
- **Secondary focus can include Economizers, QIV, DCV, T-stats, etc**

Most field technicians do not take air flow measurements

Barriers to Market Transformation

- **Price and competitive pressures**
- **Cost constraints on maintenance services**
  - Typically only non invasive preventive maintenance is performed
- **Sales challenges: end-user apathy and high cost of sales**
  - "out of sight, out of mind"
  - Most technicians do not know how to make a sales pitch
  - Cost of developing proposals
- **Technician turnover**

Market Dynamics – End Users

- **Need to perceive the value of the services including energy and non-energy benefits**
- **Must believe the benefits outweigh the cost**
- **Must be willing to purchase the new services in sufficient numbers in order for vendors to make an investment.**

Market Dynamics – Service Providers

- **May be motivated to invest in new services as a means to gain market share**
- **Need to determine that they can deliver the services profitably in the long term**
- **Must be convinced that a significant number of customers are willing to buy the service to amortize the investment.**

Program Implementation Experiences

- **NYSERDA – 3 year pilot focusing on AD of commercial HVAC systems**
- **NSTAR – 2nd year pilot focusing on "fleet management" of commercial HVAC systems**
- **SDG&E – program focusing on installation and maintenance program for both residential and commercial HVAC systems**

Common Objective and Rationale

- Objective
  - **Facilitate the adoption of a comprehensive set of services to reduce operating costs of packaged HVAC**
- Rationale
  - **Large potential benefits to customers, contractors, and the environment**
  - **Studies and experience show large benefits from best practices in equipment specification, installation and maintenance**
  - **Recent technical developments reduce the cost of delivering energy-efficient maintenance services**

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NYSERDA Overview

- **Promote the introduction of advanced diagnostic tools for refrigerant system maintenance**
- **Key Activities:**
  - Program training - HVAC Managers, Sales staff, technicians
    - AD training
    - Sales and service Manager trainings
    - Technical trainings
  - AD incentives
  - Outreach

NYSERDA (con't)

- **Available to all qualifying contractors**
- **Focused on Contractors only!**
- **Focused on Advanced Diagnostics**
- **Site Breakdown:**
  - Large Retail Chain: 7%
  - Small Businesses: 59%
  - Public Buildings: 26%
  - Other: 8%
- **Number of units per site: 5 or less = 85%**
- **Average unit size = 5.1 tons**

Summary of Program Participation

Participation Measure	Figure
Number of Advanced Diagnostics trainings Attendance at trainings	3 trainings 89 attendees from 61 businesses
Number of Sales and Service Manager trainings Attendance at trainings	3 trainings 38 attendees from 27 businesses
Number of Service Assistant Technician trainings Attendance at trainings	6 trainings 59 attendees from 26 businesses
Number of on-site technician trainings Approximate attendance at onsite trainings	22 trainings 88 attendees
Number of businesses signing program MOU Number of tools purchased	33 businesses 48 tools
Number of units tested with advanced diagnostic tools Number of commercial customers	1240 units 396 customers

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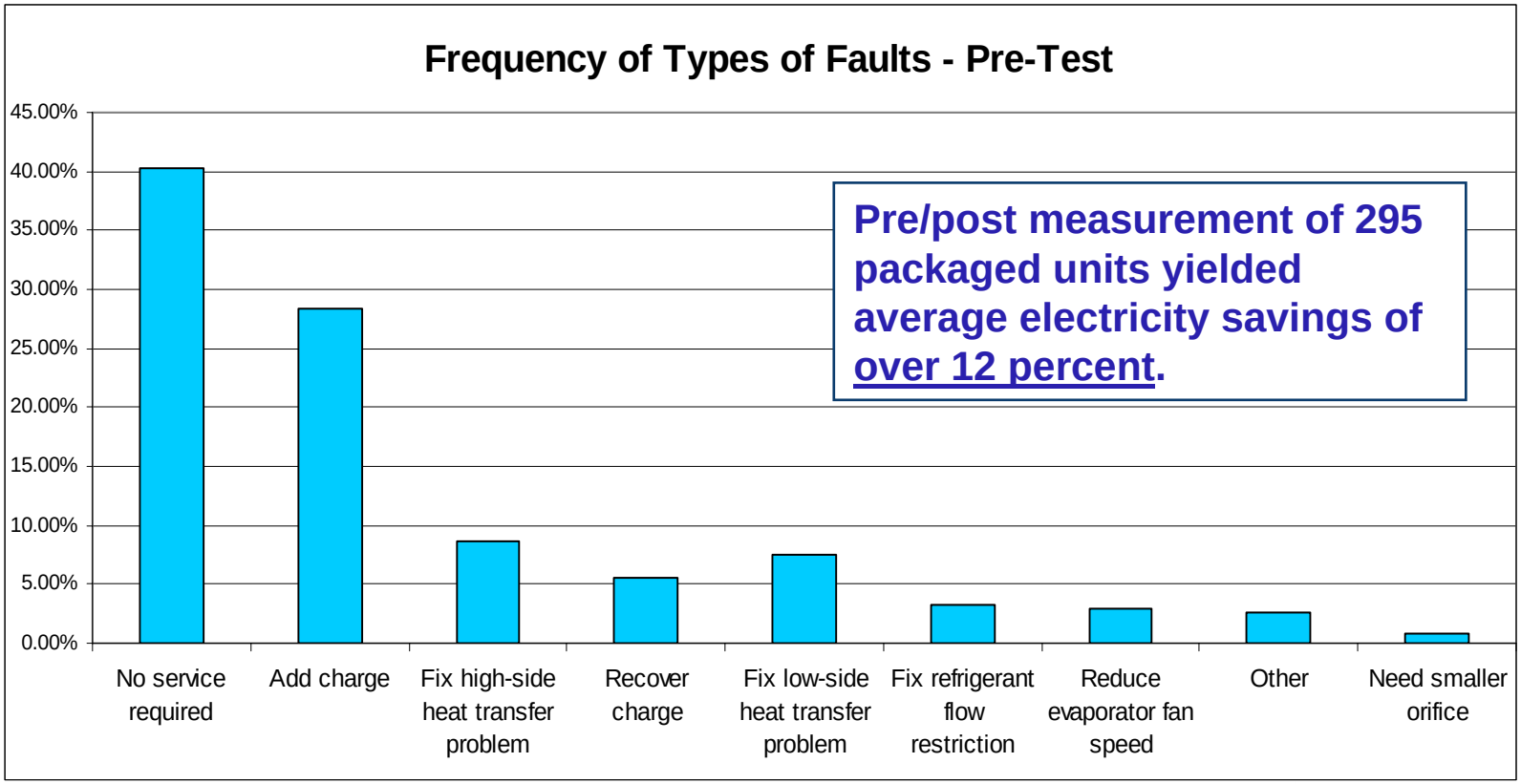
Benefits to customers of efficiency-oriented maintenance & repairs

Over a 3-year period, found faults in 55% of units inspected.



NSTAR Overview

- **Built off NYSERDA's lessons learned**
- **Expanded to comprehensive “Fleet Management”, including Economizers & DCV**
- **Dual Focus on End-users – Retail chains**
- **Focused on the 15 largest contractors (multi site)**
- **Developed automated reports**
- **Key Activities:**
  - Program training & Outreach
  - Incentives

NSTAR – year 1

- **Late start – coincided with cooling season**
- **Extensive weather & busy cooling season**
- **Labor scarcity**
- **2 Trainings: 50 attendees: 28 Contractor firms and 3 end users**
- **13 Contractors participate = 217 uploads**
- **Site Breakdown: Large Retail Chain: 90%**
- **Number of units per site: 5 or more = 70%**
- **Average unit size = 18.8 tons**
- **More success with smaller contractors**

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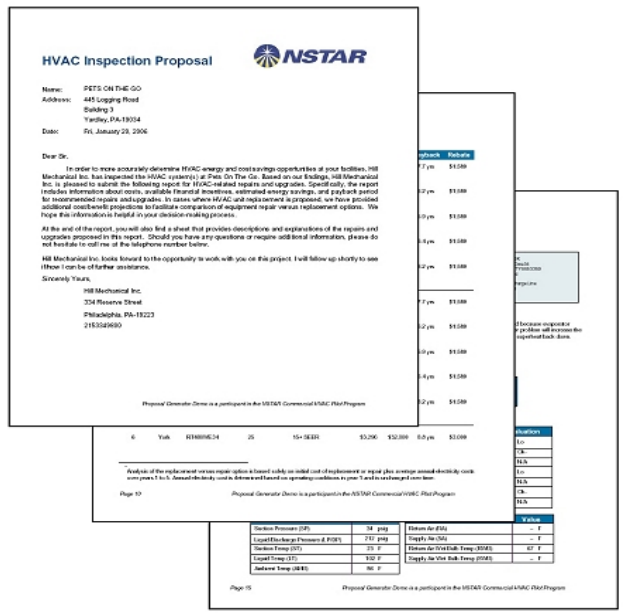
Where are we today?

Program Concept

- **HVAC Service Assistant, an advanced diagnostics tool used by field technicians during routine service calls and/or scheduled maintenance.**
- **A field-service/maintenance inspection designed to uncover/identify repair, tune-up, upgrade and replacement opportunities on buildings.**
- **Unique <u>web-based</u> software to help contractors effectively communicate the benefits of repairs, tune-ups, upgrades and replacement to customers.**



Measure Qualifications & Sales Tools

- Objectives
  - Simplify methods for identifying and qualifying program opportunities
  - Automate proposal preparation to reduce cost of sales
  - Provide clear ‘third party’ presentation of project economics

- Diagnostic Program Components
  - Standardized rooftop inspection routine and forms
  - Standardized tests for refrigeration cycle efficiency and economizer function
  - Automated sales proposal generator that details savings, costs, incentives, and ROI/payback to customer. Accessible via the Internet.

Technical & Sales Support

- Objectives
  - Minimize costs and time required to use program tools
  - Ensure process is organized ‘end-to-end’ from inspection through report, sales, installation, and incentive application
- Components
  - Customized on-site start up training for technicians, sales, and any others involved
  - Full testing of inspection and report generation process on active customer facility
  - Continuous access to technical and sales support

Technical Training Details

- **Technical Training: Class & On Site**
  - Inspection Procedures
    - ✓ Unit Inventory
    - ✓ Refrigeration Cycle Testing (Standard Charge &
    - ✓ Air Flow Measurements)
    - ✓ Economizer Test (Quick Check of Function & Set Points)
  - Use of Palm Unit to access Report Generator
  - Installation Quality Assurance Procedures

What the program provides

To the Contractor

- Training in advanced diagnostics
- Automated Sales Report Generator
- Financial Incentives for inspections, repairs, economizer repair, DCVs
- Ongoing sales and technical support

To the Customer

- Sales Report: 3rd party-endorsed roadmap to HVAC system savings & investment analysis
- Financial Incentives for purchase of high efficiency HVAC units, economizers, DCVs

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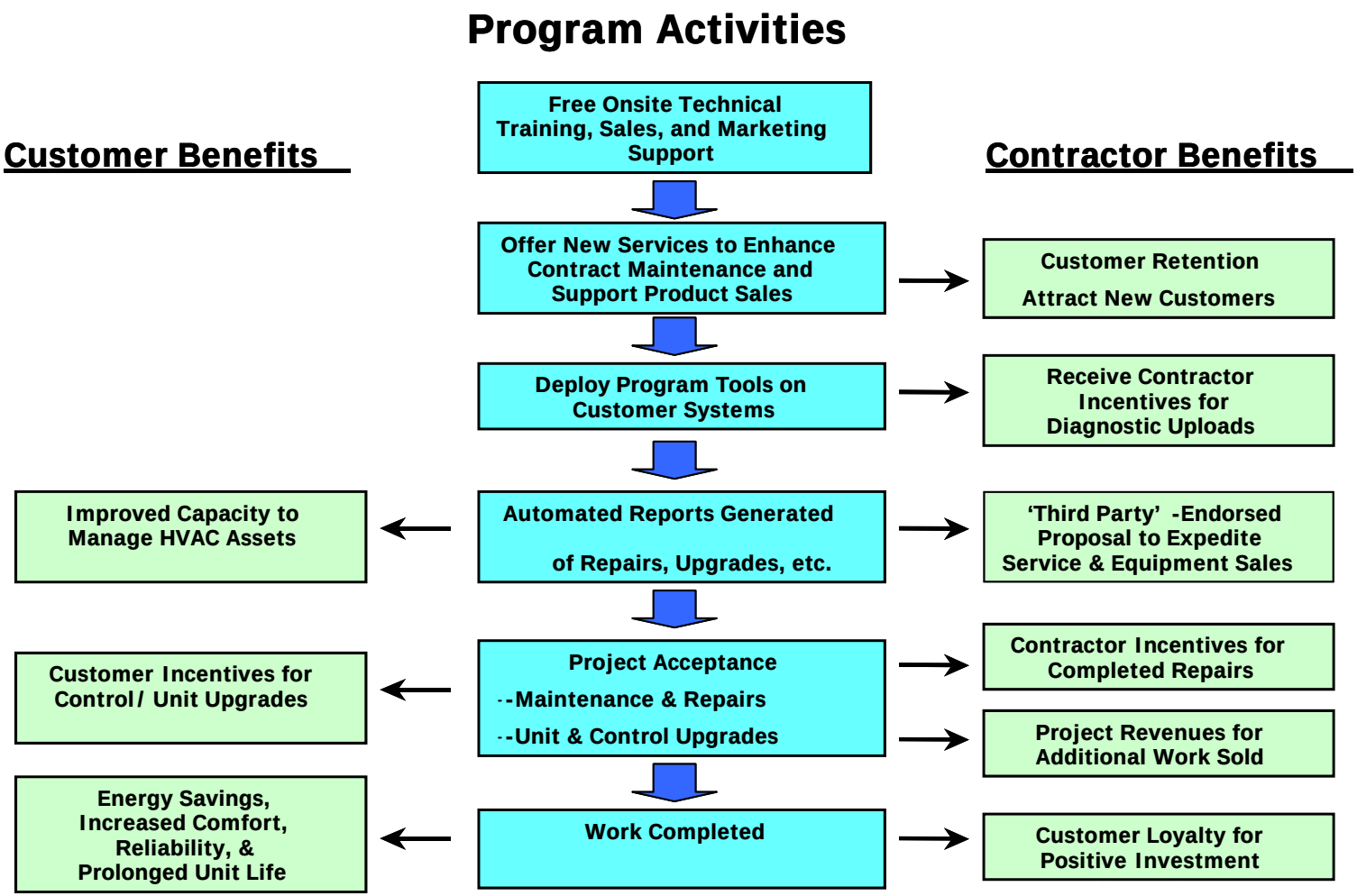
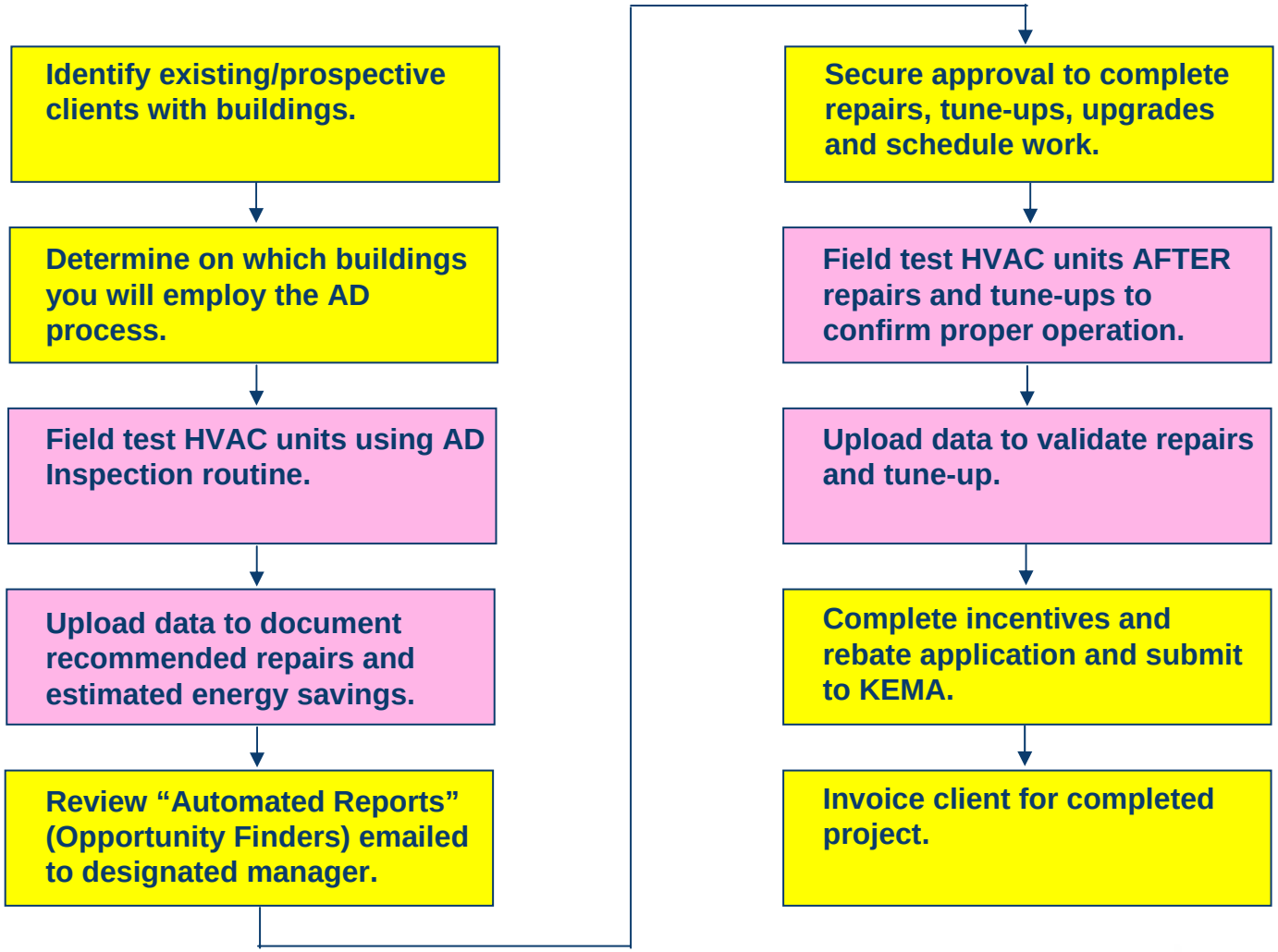
Program Value Chain



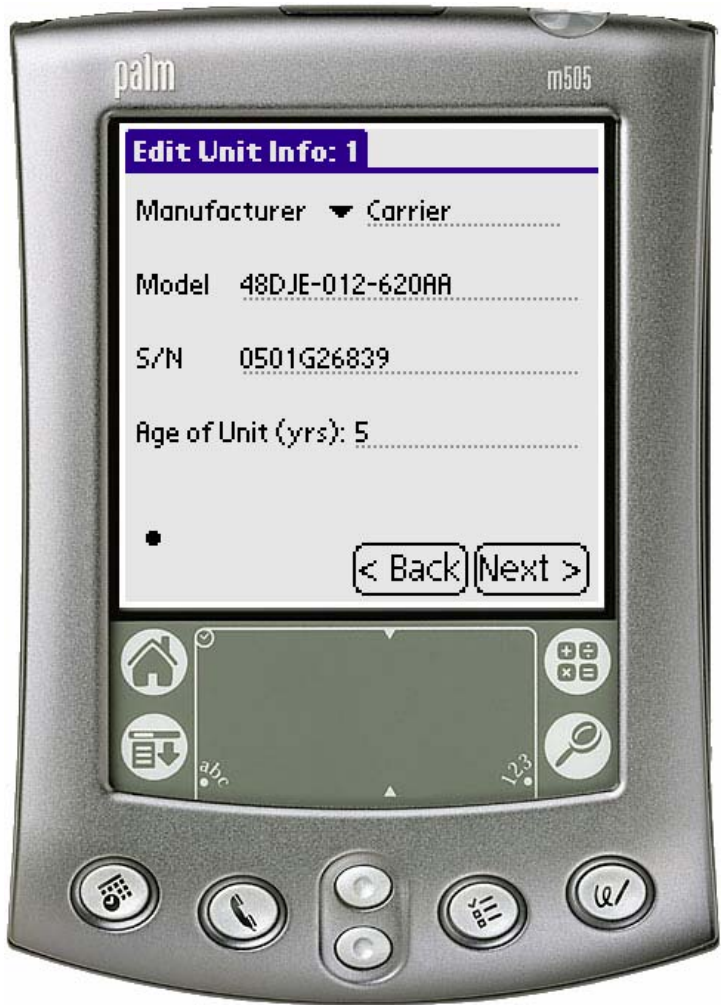
Program Process: Contractor View

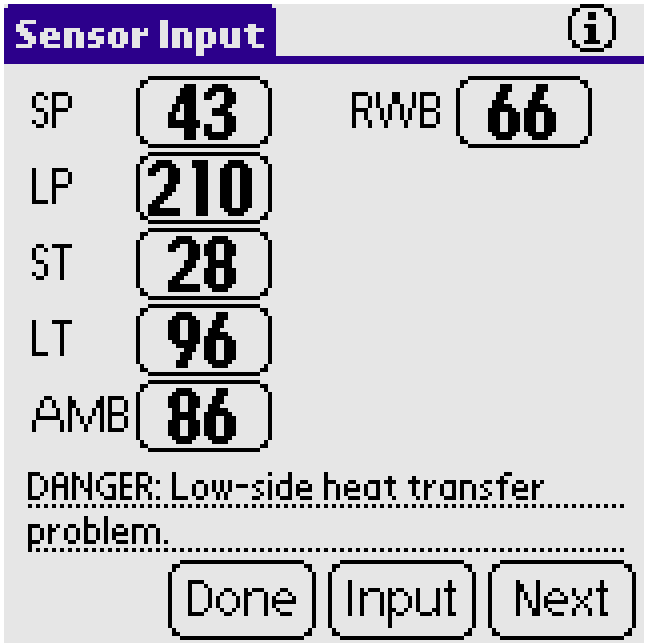


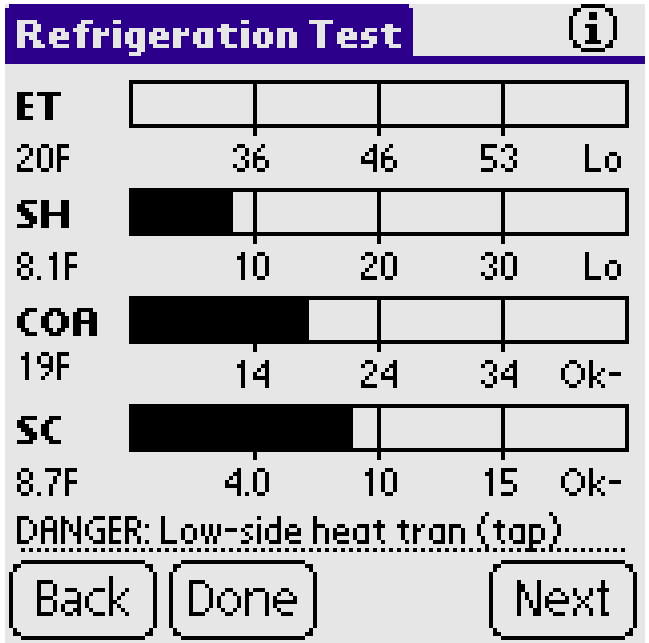
Management Function

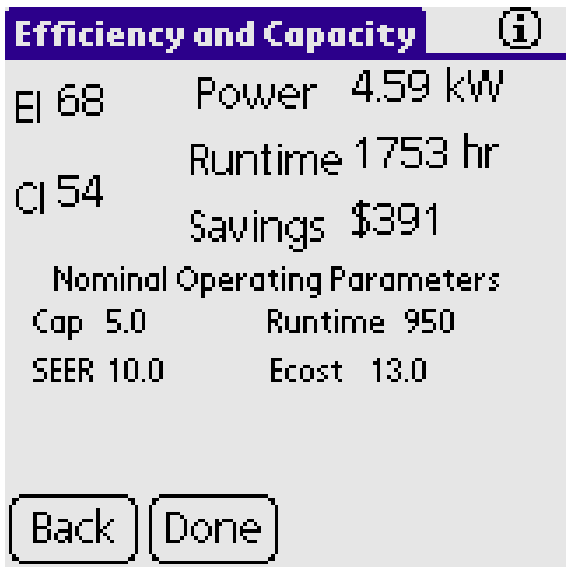
Technician Function

Palm Example




Sensor Input
SP 43
RWB 66
LP 210
ST 28
LT 96
AMB 86
DANGER: Low-side heat transfer problem.
Done
Input
Next


Refrigeration Test
ET
20F
36
46
53
Lo
SH
8.1F
10
20
30
Lo
COR
19F
14
24
34
Ok-
SC
8.7F
4.0
10
15
Ok-
DANGER: Low-side heat tran (tap)
Back
Done
Next


Efficiency and Capacity
EI 68
CI 54
Power 4.59 kW
Runtime 1753 hr
Savings $391
Nominal Operating Parameters
Cap 5.0
Runtime 950
SEER 10.0
Ecost 13.0
Back
Done

Upload Data To Document Condition

- Simple, Easy and So Important
  - Contractors get paid for uploading this information!

Automated Report Output

Reports provide a systems overview, detailing the status of all units inspected at a given location, regardless of whether or not additional maintenance, repairs, or upgrades are recommended.

REPAIR OPPORTUNITIES

Unit	Zone	Age	Stage	EI	CI	Diagnosis	Proposed Repairs	Savings
3	General Sales Area	5	1	80	76	DANGER: Add charge.	Leak, Check & Repair	$288
6	General Sales Area	8	1	75	71	DANGER: Refrigerant flow restriction.	Cleaning Coil	$376
8	General Sales Area	12	1	100	89	DANGER: Add charge.	Leak, Check & Repair	$14

Total Investment for Repairs:	$ 470
Estimated Annual Energy Savings:	$ 678
Payback Period:	0.7 yrs

UPGRADE OPPORTUNITIES

Unit	Make	Model	Zone	Age	Proposed Upgrades	Savings
6	Trane	YCD150	General Sales Area	8	Add Dual Sensor Enthalpy	$705

Total Investment for Upgrades:	$ 700
Rebate Amount:	$ 250
Estimated Annual Energy Savings:	$ 705
Payback Period:	0.6 yrs

Measures & Incentives

Contractor Incentives

HVAC Measure	Rebate
Submission of Diagnostic Data	$25/stage
Completed Tune-ups/Repairs	$40/stage
Economizer Restoration	$250/unit
Demand-Controlled Ventilation Installation	$300/unit
Set-Back Thermostat Installation or Adjustment*	$40/thermostat

Customer Incentives

HVAC Measure**	Rebate
HVAC Unit Efficiency Upgrade	$73-92/ton
Dual Enthalpy Economizer Installation	$250/unit
Demand-Controlled Ventilation Installation	$200/unit

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What have we learned?

- **Programs require significant “on-site” training**
- **Need to work through contractors – customers turn to them once every 15 years**
- **This is not a 2 year program – we need to weed out the old timers who live by short cuts**
- **Don’t expect big savings in year 1**
- **Simplify paperwork**
- **Timing is everything**
- **You can’t plan for the weather**

Additional Market Opportunities

- **Quality Installations**
- **Expand the market to include both residential and commercial systems**
- **Provide AD services to new equipment and existing equipment**
- **Engage local trade associations such as ACCA**