U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Home Improvement Catalyst: Advancing High Performance HVAC

September 2017

Optimizing HVAC System Performance

3 million HVAC replacements annually

$14 billion HVAC service/repair expenditures annually

Research indicates 50% to 70% of systems are improperly designed, installed, or maintained
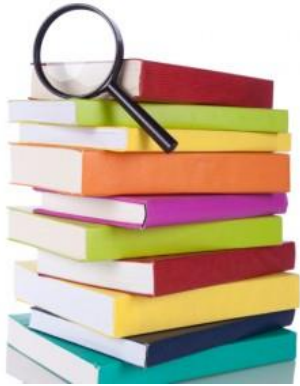

Improper installations are estimated to be 10% to 50% less efficient than they should be

Our Opportunity:
Improve field performance of HVAC system installation with **selection guidance for verification tools**

Review of Current State of Practice

Conducted **systematic literature review** gathering reports and results on the impacts to performance from improper HVAC installation

- Reviewed 35+ reports, outreach to industry experts, utilities, and REEOs
- Primary focus: existing homes HVAC replacement market

Equipment Installation → System performance ← Distribution System Condition ← Operations & Maintenance
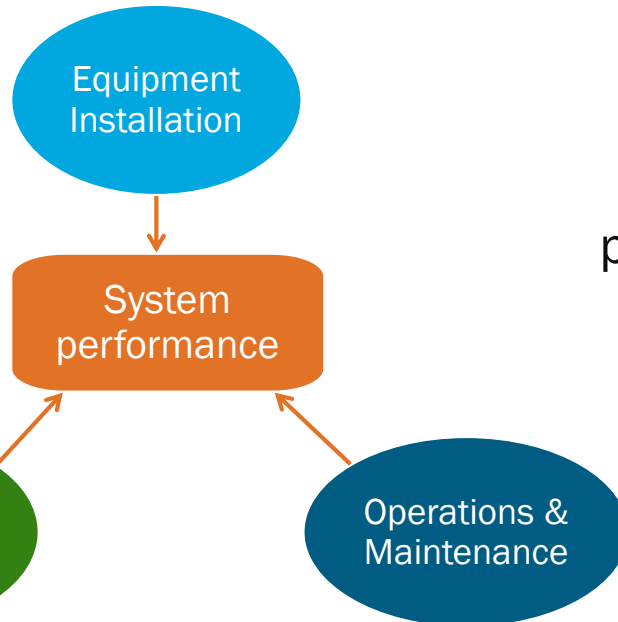
Key Finding:
Trades, in-field experts, and programs should **utilize installation verification** tools to **diagnose and correct** problems

Report available here:
https://rpsc.energy.gov/tech-solutions/hvac

Creating a Snapshot

- **Our Approach**
  - Conducted a market scan
  - Categorized "tools" by core function and type
  - Focused on commercial software tools and products for collecting and analyzing data on HVAC system performance

- **Visual Resources Available**
  - High level visual guide to understand the variety of tools available and their primary functions
  - Selection and Comparison Matrix to assist in identifying verification tools for use in specific applications

DATA

SORTED

ARRANGED

PRESENTED VISUALLY
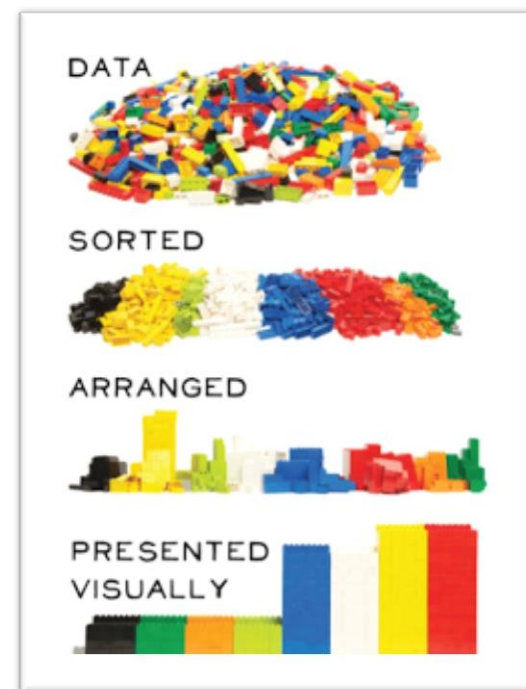
HVAC Installation Verification Tools

Defining Core Functions:

- **Design:** Load calculation, sizing, equipment selection, and system design
  - ACCA Manual Software
  - OEM and third-party Sizing Apps

- **Commissioning and Verification:** Smart service tools, extended analysis, and airflow direct measurement
  - System Analysis Software
  - Refrigeration: Digital Gauges and Manifolds
  - Airflow Tools
  - System Analysis Hardware

- **Performance Monitoring:** OEM installed or after market sensors and software for capacity and system performance monitoring
  - 24/7: Hardware/Sensors or Software as a System (SAAS)
  - Wi-Fi Thermostats
  - Smart Thermostats
  - Indoor Air Quality Monitors

MARKET SNAPSHOT 2017: HVAC Installation Verification Tools*

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* Companies and logos presented in this Market Snapshot are illustrative examples of products available in their category (as of August 31, 2017). Their presentation in this Market Snapshot is for identification purposes only and does not indicate any product endorsement by the US Department of Energy or association with its trademark owner.

Installation Verification Tool Selection Guide

Selection Guide available here:
https://rpsc.energy.gov/tech-solutions/hvac

Matrix documents installation verification tools by:

- Target audience, system type, capability, features and benefits and example products

- Designed as summary guidance to help contractors, programs, utilities and others in selecting the appropriate installation verification tools

Next steps...

Understanding Key Performance Indicators (KPIs)

- Summarize performance measurements (e.g., refrigerant charge, airflow, static pressure, etc.) used when installing HVAC systems
  - Follows industry standards (ACCA 5) and OEM specs
- Are NOT intended to be used as an installation checklist or process
- Recommend: industry and OEM standards

KPIs provide the basis for establishing performance criteria for field verification tools

Field Verification Tool Performance Criteria:

Provides the key measurement capabilities, tolerances, analytical capacity, etc. for diagnostic and monitoring tools

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