

# BEST PRACTICES GUIDE FOR RESIDENTIAL HVAC RETROFITS

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## INTRODUCTION

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This best practices guide for residential HVAC system retrofits is aimed at contractors who want guidance on delivering energy efficient, cost effective and innovative products. It has been developed around the idea of having packages of changes to the building HVAC system and building envelope that are climate and house construction dependent. These packages include materials, procedures and equipment and are designed to remove some of the guesswork from a builder, contractor, installer or homeowner decisions about how best to carry out HVAC changes. The packages are not meant to be taken as rigid requirements – instead they are systems engineered guidelines that form the basis for energy efficient retrofits. Similar approaches have been taken previously for new construction to develop extremely energy efficient homes that are comfortable safe and durable, and often cost less than standard construction. This is best epitomized by the Building America program whose partners have built thousands of residences throughout the U.S. using these principles. The [differences between retrofitting and new construction](#) tend to limit the changes one can make to a building, so these packages rely on [relatively simple](#) and non-intrusive technologies and techniques. The retrofits also focus on changes to a building that will give many [years of service](#) to the occupants.

Another key aspect of these best practices is that we need to know how a house is working so that we know what parts have the potential for improvement. To do this we have put together a set of diagnostic tools that combine physical measurements and checklists/questionnaires. The measured test results, observations and homeowner answers to questions are used to direct us towards the best retrofits applicable to each individual house. The retrofits will depend on the current condition of the building envelope and HVAC system, the local climate, the construction methods used for the house, and the presence of various energy saving systems (e.g., a Heat Recovery Ventilator) and/or materials. This is just like a doctor referring a patient for blood tests or x-rays before actually performing surgery. This way the doctor can be sure that he does the right thing. To take this analogy further – we can borrow from the medical profession and say that the first thought when retrofitting a house is to do no harm, i.e., do not make changes that could make the house worse to live in.

This guide was developed in conjunction with input from many [members of the HVAC industry and research community](#). Thanks to all those who participated.

# **Best Practices Guide For Residential Hvac Retrofits**

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## **Best Practices Guide For Residential Hvac Retrofits:**

*Best Practices Guide for Residential HVAC Retrofits* Iain S. Walker, 2003 This best practices guide for residential HVAC system retrofits is aimed at contractors who want guidance on delivering energy efficient cost effective and innovative products It has been developed around the idea of having packages of changes to the building HVAC system and building envelope that are climate and house construction dependent These packages include materials procedures and equipment and are designed to remove some of the guesswork from a builder contractor installer or homeowner decisions about how best to carry out HVAC changes The packages are not meant to be taken as rigid requirements instead they are systems engineered guidelines that form the basis for energy efficient retrofits Similar approaches have been taken previously for new construction to develop extremely energy efficient homes that are comfortable safe and durable and often cost less than standard construction This is best epitomized by the Building America program whose partners have built thousands of residences throughout the U S using these principles The differences between retrofitting and new construction tend to limit the changes one can make to a building so these packages rely on relatively simple and non intrusive technologies and techniques The retrofits also focus on changes to a building that will give many years of service to the occupants Another key aspect of these best practices is that we need to know how a house is working so that we know what parts have the potential for improvement To do this we have put together a set of diagnostic tools that combine physical measurements and checklists questionnaires The measured test results observations and homeowner answers to questions are used to direct us towards the best retrofits applicable to each individual house The retrofits will depend on the current condition of the building envelope and HVAC system the local climate the construction methods used for the house and the presence of various energy saving systems e g a Heat Recovery Ventilator and or materials This is just like a doctor referring a patient for blood tests or x rays before actually performing surgery This way the doctor can be sure that he does the right thing To take this analogy further we can borrow from the medical profession and say that the first thought when retrofitting a house is to do no harm i e do not make changes that could make the house worse to live in

**Homeowner Best Practices Guide for Residential Retrofits**, 2005 This best practices guide for HVAC system retrofits is aimed at homeowners who want guidance on upgrading their heating cooling and ventilation HVAC systems and integrating these upgrades with other changes to their home It has been developed around the idea of having packages of changes to the building HVAC system and building envelope that are climate and house construction dependent These packages include materials procedures and equipment and are designed to remove some of the guesswork when selecting a builder contractor or installer The packages are not meant to be taken as rigid requirements instead they are systems engineered guidelines that form the basis for energy efficient retrofits Similar approaches have been taken previously for new construction where a systems engineering approach has been used to develop extremely energy efficient homes that are comfortable safe and durable and often cost less than

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*Home Energy Article* Iain S. Walker, Jennifer A. McWilliams, 2005 Over the past couple of years a Best Practices Guideline for Residential HVAC Retrofits has been developed by the US Department of Energy DOE to provide guidance for contractors in performing whole house retrofits Because of the strongly cost limited nature of retrofits combined with the wide range of existing home performance the DOE guideline has several levels of retrofit packages depending on the level of intervention that a homeowner can afford or is justified by the condition of the home and its HVAC system The packages are pre selected combinations of individual retrofit activities that provide simple whole house guidance for contractors This guideline has been evaluated by potential users such as contractors and weatherization experts Part of this evaluation included a field pilot study applying the guidelines to eight test houses The application of the guidelines to these houses resulted in feedback that helped to update and improve the guidelines In order to have an independent assessment of the guidelines two of the houses were evaluated by an independent energy efficiency contractor One of the test houses was chosen to be retrofitted and had the Best Practices Guideline diagnostic screening tests repeated after the retrofit to compare pre and post retrofit performance as well as being the subject of extensive monitoring to determine the change in house performance due to the retrofit More details of these test results and the application and development of the Retrofit Guide can be found in Walker 2003

**Case Study Field Evaluation of a Systems Approach to Retrofitting a Residential HVAC System**, 2003 This case study focusing on a residence in northern California was undertaken as a demonstration of the potential of a systems approach to HVAC retrofits The systems approach means that other retrofits that can affect the HVAC system are also considered For example added building envelope insulation reduces building loads so that smaller capacity HVAC system can be used Secondly we wanted

to examine the practical issues and interactions with contractors and code officials required to accomplish the systems approach because it represents a departure from current practice We identified problems in the processes of communication and installation of the retrofit that led to compromises in the final energy efficiency of the HVAC system These issues must be overcome in order for HVAC retrofits to deliver the increased performance that they promise The experience gained in this case study was used to optimize best practices guidelines for contractors Walker 2003 that include building diagnostics and checklists as tools to assist in ensuring the energy efficiency of house as a system HVAC retrofits The best practices guidelines proved to be an excellent tool for evaluating the eight existing homes in this study and we received positive feedback from many potential users who reviewed and used them In addition we were able to substantially improve the energy efficiency of the retrofitted case study house by adding envelope insulation a more efficient furnace and air conditioner an economizer and by reducing duct leakage

**Revitalize and Renew: A Comprehensive Guide to Retrofit and Renovation Projects** Charles Nehme , Purpose of the Book In today s world where sustainability and energy efficiency have become paramount the significance of retrofitting and renovation has never been more relevant This book Revitalize and Renew A Comprehensive Guide to Retrofit and Renovation Projects is designed to be a definitive resource for anyone looking to breathe new life into existing structures Whether you are a homeowner eager to modernize your living space an architect aiming to balance aesthetics with functionality or a contractor seeking to enhance your expertise this book will guide you through the process of transforming old outdated buildings into efficient sustainable and beautiful spaces The primary purpose of this book is to equip you with the knowledge and tools necessary to make informed decisions about retrofit and renovation projects It aims to demystify the processes involved provide actionable steps and inspire creativity in the pursuit of both functional and aesthetic improvements By the end of this book you will be well prepared to embark on your own renovation journey whether it involves minor updates or a complete overhaul Scope of the Book Retrofit and renovation are often used interchangeably yet they serve different purposes and involve distinct processes This book clearly distinguishes between the two while also showing how they can be complementary in creating modern efficient buildings that respect their historical roots Retrofit typically involves the addition of new technology or features to an existing building with a strong focus on improving energy efficiency safety and resilience to environmental challenges Examples include upgrading insulation installing solar panels or reinforcing structures against seismic activity Renovation on the other hand focuses more on restoring or improving the physical aspects of a building such as its structure interiors and exteriors often for aesthetic purposes modernization or to repair damage In this book we will explore both concepts in depth providing detailed guidance on a wide range of projects from small scale updates to large scale transformations The book is divided into several key sections Foundations of Retrofitting and Renovation A thorough exploration of the basics including the differences between retrofitting and renovation the initial assessments required and how to plan and design a project that meets your goals Key

Retrofit and Renovation Projects A hands on guide to specific projects including structural enhancements energy efficiency improvements electrical and plumbing upgrades and both interior and exterior renovations Sustainability and Future Proofing As environmental concerns grow this section focuses on green retrofitting strategies smart home technologies and designing for health wellness and long term sustainability Case Studies and Practical Examples Real world examples and DIY project guides that provide inspiration and practical advice for various types of retrofit and renovation projects Managing and Completing Your Project A deep dive into project management budgeting financing and post renovation considerations to ensure that your project is successful from start to finish The Growing Importance of Retrofitting and Renovation The modern built environment is facing unprecedented challenges from climate change to aging infrastructure Retrofitting and renovation offer solutions that not only enhance the functionality and safety of buildings but also contribute to environmental sustainability Retrofitting in particular has gained momentum as a crucial strategy for reducing energy consumption and lowering carbon footprints aligning with global efforts to combat climate change Moreover renovating existing buildings rather than constructing new ones can preserve historical and cultural values reduce the demand for new materials and minimize waste As cities become more crowded and the need for housing and commercial space grows the efficient use of existing structures through thoughtful renovation becomes increasingly important Who Should Read This Book This book is intended for a diverse audience Homeowners who want to update their homes improve energy efficiency or increase property value Architects and Designers seeking inspiration and technical knowledge to incorporate into their projects Contractors and Builders looking to expand their skills and expertise in retrofitting and renovation DIY Enthusiasts interested in undertaking their own renovation projects with confidence Real Estate Professionals aiming to understand the impact of retrofitting and renovation on property value and marketability Conclusion As you embark on the journey of retrofitting or renovating a building this book will serve as your comprehensive guide It will help you navigate the complexities of these projects offering practical advice inspiring ideas and a roadmap to success Whether you are preserving the charm of a historic home upgrading an outdated office building or making your home more energy efficient Revitalize and Renew is here to support you every step of the way

**Deep Energy Retrofit Guide for Public Buildings** Rüdiger Lohse,Alexander Zhivov,2019-04-10 This book provides detailed information on how to set up Deep Energy Retrofits DERs in public buildings and shares in depth insights into the current status of the major technologies strategies and practical best practice examples of how to cost effectively combine them Case studies from Europe are analyzed with respect to energy use before and after renovation reasons for undertaking the renovation co benefits achieved resulting cost effectiveness and the business models employed The building sector holds the potential for tremendous improvements in terms of energy efficiency and reducing carbon emissions and energy retrofits to the existing building stock represent a significant opportunity in the transition to a low carbon future Moreover investing in highly efficient building materials and systems can replace long term energy imports

contribute to cost cutting and create a wealth of new jobs Yet while the technologies needed in order to improve energy efficiency are readily available significant progress has not yet been made and best practices for implementing building technologies and renewable energy sources are still relegated to small niche applications Offering essential information on Deep Energy Retrofits the book offers a valuable asset for architects public authorities project developers and engineers alike

A Systems Approach to Retrofitting Residential HVAC Systems ,2004 A Best Practices Guide for retrofitting residential HVAC systems has recently been completed by DOE The guide uses diagnostics and checklists to guide the user to specific retrofit packages that maximize retrofit energy savings comfort and safety potential The guide uses a systems approach to retrofitting where the interaction of different building components is considered throughout the retrofit selection process For example added building envelope insulation reduces building loads so that smaller capacity HVAC systems can be used In this study several houses were surveyed using the Best Practices Guide and a single house was selected for retrofitting The objectives were to demonstrate how a successful system wide retrofit can be carried out and to provide feedback to improve the guide Because it represents a departure from current practice a key aspect of this study was to investigate the interactions with contractors and code officials who are unfamiliar with the systems approach The study found that the major barrier to the systems approach in retrofits was in changing the working practices of contractors and code officials

Status of the Natural Gas Research, Development and Demonstration Program for FY 2009-2010 : Interim Report to the Public Utilities Commission ,2010

**Whole House Contracting Protocols Project: Reference manual for instructors : best practice protocols for home performance contractors** ,2007

**Radiant Heating and Cooling and Measured Home Performance for California Homes** Larry Brand (Engineering R & D professional),Will Allen,Gas Technology Institute,Western Cooling Efficiency Center,2013

**Energy Audit of Building Systems** Moncef Krarti,2020-12-01 Updated to include recent advances this third edition presents strategies and analysis methods for conserving energy and reducing operating costs in residential and commercial buildings The book explores the latest approaches to measuring and improving energy consumption levels with calculation examples and Case Studies It covers field testing energy simulation and retrofit analysis of existing buildings It examines subsystems such as lighting heating and cooling and techniques needed for accurately evaluating them Auditors managers and students of energy systems will find this book to be an invaluable resource for their work Explores state of the art techniques and technologies for reducing energy combustion in buildings Presents the latest energy efficiency strategies and established methods for energy estimation Provides calculation examples that outline the application of the methods described Examines the major building subsystems lighting heating and air conditioning Addresses large scale retrofit analysis approaches for existing building stocks Introduces the concept of energy productivity to account for the multiple benefits of energy efficiency for buildings Includes Case Studies to give readers a realistic look at energy audits Moncef Krarti has vast experience in designing testing

and assessing innovative energy efficiency and renewable energy technologies applied to buildings He graduated from the University of Colorado with both MS and PhD in Civil Engineering Prof Krarti directed several projects in designing energy efficient buildings with integrated renewable energy systems He has published over 3000 technical journals and handbook chapters in various fields related to energy efficiency distribution generation and demand side management for the built environment Moreover he has published several books on building energy efficient systems Prof Krarti is Fellow member to the American Society for Mechanical Engineers ASME the largest international professional society He is the founding editor of the ASME Journal of Sustainable Buildings Cities Equipment and Systems Prof Krarti has taught several different courses related to building energy systems for over 20 years in the United States and abroad As a professor at the University of Colorado Prof Krarti has been managing the research activities of an energy management center at the school with an emphasis on testing and evaluating the performance of mechanical and electrical systems for residential and commercial buildings He has also helped the development of similar energy efficiency centers in other countries including Brazil Mexico and Tunisia In addition Prof Krarti has extensive experience in promoting building energy technologies and policies overseas including the establishment of energy research centers the development of building energy codes and the delivery of energy training programs in several countries

*Natural Gas Energy Efficiency in Buildings* Betty Seto, DNV KEMA Energy and Sustainability, DNV GL (Firm), 2014

**Energy Smart Communities**, 2004

**Measured Home Performance** Lew Harriman, Rick Chitwood, 2011-11-01 This report to the California Energy Commission's Public Interest Energy Research Program PIER helps Home Performance Contractors train their crews to achieve superior results in home energy retrofits The book was updated and expanded in December of 2012 to include the impressive measured results from 15 home energy retrofits in Redding California that were accomplished using the principles and practices outlined in this report Homeowners may also find this information useful when they want to understand the techniques that regularly achieve utility bill savings of 40 to 70% on an annual basis This approach called Measured Home Performance is different from other means of saving energy Most importantly all of the home's energy features are redesigned and improved at the same time so the synergies take effect immediately Next measurements are taken all the way through the process to ensure that both the redesign and the installation are excellent Improved comfort and energy savings are assured by high tech field measurements taken by the craftspeople themselves rather than by 3rd party auditors This process provides real time feedback to the real decision makers the technicians who do the work Measurements of critical parameters like duct air leakage whole house air leakage supply air flow at each grill CO concentration draft pressure of combustion appliances and superheat and subcooling of the AC equipment make the installation quality good or poor are instantly clear to the crews They can fix any shortcomings on the spot rather than waiting days or weeks for 3rd party testing results Craftspeople measuring key parameters as they work transforms the workplace Measured quality not only ensures successful results for the homeowners it self trains crew



members in the field where they learn more quickly than in the classroom At the end of every day workers know when they have achieved excellent results a powerful motivator that works to everybody s benefit

**Natural Gas Research and Development ... Annual Report** California Energy Commission. Energy Research and Development Division,2014

Proceedings of the 5th International Conference on Building Energy and Environment Liangzhu Leon Wang,Hua Ge,Zhiqiang John Zhai,Dahai Qi,Mohamed Ouf,Chanjuan Sun,Dengjia Wang,2023-09-04 This book is a compilation of selected papers from the 5th International Conference on Building Energy and Environment COBEE2022 held in Montreal Canada in July 2022 The work focuses on the most recent technologies and knowledge of building energy and the environment including health energy urban microclimate smart cities safety etc The contents make valuable contributions to academic researchers engineers in the industry and regulators of buildings As well readers encounter new ideas for achieving healthy comfortable energy efficient resilient and safe buildings

**Small and Medium Building Efficiency Toolkit and Community Demonstration Program** Mary Ann Piette,Lawrence Berkeley National Laboratory,2019

**Architectural Security Codes and Guidelines** Robert C. Wible,2007 Presents the guidelines you need to create safer and secure buildings This resource provides you with what to do now information as important building codes such as the International Building Code and the National Electrical Code This reference presents the guidelines you need to create safer more secure buildings This is the only resource that provides you with what to do now information as important building codes such as the International Building Code and the National Electrical Code are in the process of being updated From a conceptual understanding of regulatory processes to checklists and guidelines for applying codes and standards this reference provides you with a way to create safer more secure buildings

*How to Retrofit an Old HVAC System for Better Performance* Charles Nehme, In today s world energy efficiency and sustainability are at the forefront of HVAC system design and operation However many buildings still rely on aging HVAC systems that were installed decades ago While these systems may continue to function they often operate inefficiently consume excessive energy and struggle to meet modern comfort and air quality standards Retrofitting an existing HVAC system is a cost effective alternative to complete system replacement It allows building owners and facility managers to enhance performance improve energy efficiency and extend the lifespan of their equipment while minimizing capital investment Through targeted upgrades such as better air distribution smart controls high efficiency components and environmentally friendly refrigerants older HVAC systems can be transformed to meet today s performance expectations This guide provides a structured approach to retrofitting HVAC systems outlining key steps best practices and advanced solutions that can help achieve better indoor climate control lower operational costs and reduced environmental impact Whether you are an engineer building manager or property owner this book will equip you with the knowledge needed to optimize an aging HVAC system without a full scale replacement Let s dive into the strategies that can modernize your HVAC system for improved efficiency and reliability

**Energy Abstracts for Policy Analysis**

,1982

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