
CERTIFICATE ENDORSEMENT CURRICULA FOR EE/RE TECHNOLOGIES

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Energy Efficiency and Renewable Energy (EE/RE) Training Program Texas Workforce Commission Project

Introduction

The Energy Systems Laboratory (ESL) at the Texas Engineering Experiment Station (TEES) of the Texas A&M University System is the recipient of a grant to develop and implement a training program related to Energy Efficiency/Renewable Energy, and the 2009 International Energy Conservation Code (IECC).

This project is funded by the Workforce Investment Act (WIA) and the American Recovery and Reinvestment Act of 2009 (ARRA) through the Texas Workforce Commission.

Development of training curricula. The goal of this project is the development of training curricula related to EE/RE in the fields of Carpentry, Electrical, HVAC, and Plumbing for entry level workers and for incumbent technicians. The need for a skilled workforce is increasing, and a large population of skilled technicians is required for work in the industrial sectors related to EE/RE. This demand in the workforce can be met by enhancing the skills of incumbent building trades' technicians and addressing their skill deficiencies in EE/RE, as well as by preparing new entry-level technicians.

Development of the industry-driven Task Lists and their use as the foundation for curricula. The development of the curricula is based on five industry-driven task lists related to EE/RE and IECC. The task lists provide a set of performance standards needed by workers to meet the current requirements of the EE/RE industries and the Texas Building Energy Performance Standards. The methodology for this development was based on the published research (For further information and citations: Bastani, 1999, Texas A&M University, College Station, Texas). The task lists provide the foundation for comprehensive Technical Skills Training (TST) programs for Carpenters, Electricians, HVAC Technicians, and Plumbers.

Per definition: Task List (Task Inventory) is a list of the various tasks that require mastery level of performance for an individual to satisfy the requirements of a job. Therefore, the task lists indicate much needed competencies in the fields of EE/RE for our workforce.

This document contains four new proposed curricula for Certificate Endorsement in EE/RE for: 1)Carpenters 2)Electricians 3) HVAC Technicians 4) Plumbers, and one for Entry-level technicians (general).

The task lists associated with the proposed curricula appear in Appendix A.

These materials will be available through the Texas Higher Education Coordinating Board to interested Community Colleges and Technical Institutes. These institutions would be able to adopt and offer the recommended courses and upon successful completion of the program, issue a "Certificate Endorsement in EE/RE" to their students/trainees.

Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project

Certificate Endorsement in EE/RE

Program Description

This program is designed to prepare students/trainees for the high-wage jobs in the “Green” construction industries. The focus of this technical skills training program is to provide much needed fast-track training and development to the general population of technicians, primarily in the trades of Carpentry, Electrical, HVAC, and Plumbing.

The community colleges and technical institutes will be able to offer a Certificate of Endorsement in EE/RE (or prepare entry level workers for certification) in three possible educational/training activities: 1) As an Endorsement to a college degree and/or for courses included in a degree program, 2) As a stand-alone course offering for certification at a college, and 3) As a short term, intensive, customized training certification offered to employees of a business.

Curricula and Courses

This document contains five new proposed curricula for Certificate Endorsement in EE/RE. The curricula are for: carpenters, electricians, HVAC technicians, plumbers, and entry-level technicians (general).

The curriculum for each trade specialty includes two courses. The curriculum for the entry level technicians includes one course.

The course “An introduction to EE/RE Technologies” is a course common for all of the proposed curricula. This course is offered as the only course for the entry-level technicians, and as the first course in each of the four trade-specialty curricula. This course would be a prerequisite to a second course on specialized knowledge and skill base for the specific trade.

Each course is recommended to be equivalent to Three (3) Semester Hours earning Three (3) credits.

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“An Introduction to EE/RE Technologies” Course Outline

- Career Path in EE/RE Technicians
- Basic Energy Efficiency (EE) Skills
- Basic Energy and Related Systems and their components
 - Selection, Installation, Maintenance, and Repair
- Energy Efficiency Technologies Related to Basic EE/RE
- Energy Efficiency Equipment, Related Basic Skills
- Building Science Related to Basic EE
- Current IECC Basic
- Assessment Related to Basic EE Requirements
- Basic Renewable Energy (RE) Skills
- Renewable Energy Related Systems and Their Components
 - Basic Solar Energy Systems
 - Basic Wind Energy Systems
 - Basic Geo-Thermal Systems
- Basic Renewable Energy Technologies
- Building Science Related to Basic RE
- Assessment Related to Basic RE Requirements
- Members of the Building Trade Team
- Terms and Definitions for Basic EE/RE
- Units of Instruction for Basic EE/RE
- Selected Online References and Resources for EE/RE

Terms and Definitions for “An Introduction to EE/RE Technologies”

List of Terms from and/or related to Basic Task List, Basic IECC Code, and Basic Building Science (expanded by instructor/trainer as needed).

Examples:

Duct: A tube or conduit used to convey air.

Infiltration: The uncontrolled inward air leakage into a building.

Insulating sheeting: An insulating board with a core material having a minimum R-2 value.

Thermal envelope: Thermal insulation within the building enclosure.

Construction waste: Unwanted materials from a construction site.

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Material management: Movement of materials and components within a construction site.

Productivity: The quality of being productive.

Environmental protection: The practice of protecting the environment, on individual, organizational, or governmental level, for the benefit of the natural environment.

Units of Instruction for “An Introduction to EE/RE Technologies”

Unit #	Unit of Instruction
1	Students will become familiar with the overview of building systems
2	Students will become familiar with the management of construction waste (waste reduction and recycling methods)
3	Students will become familiar with site safety
4	Students will become familiar with the proper use of material management; reduce construction waste
5	Students will become familiar with all aspects of communication and seeking guidance from other professionals
6	Students will become familiar with the proper education of consumers
7	The students will learn the proper coordinating activities among all trades
8	Students will become familiar with productivity vs. quality concepts (increasing knowledge)
9	Students will become familiar with priority of tasks and installation sequence among trades
10	Students will become familiar with the proper selection of materials
11	Students will become familiar with environmental protection
12	Students will learn the concept of team meetings before starting a job

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13	Students will become familiar with energy efficient and advanced framing
14	Students will become familiar with the proper installation procedures for all systems
15	Students will become familiar with the proper installation of thermal barriers
16	Students will become familiar with daylight harvesting in all buildings
17	Students will become familiar with the commissioning process
18	Students will become familiar with design elements related to buildings with insulation technology
19	Students will become familiar with the impact on climate zone and design temperature
20	Students will become familiar with true orientation and its impact on EE

Selected Online References and Resources for “An Introduction to EE/RE Technologies”

Advanced Energy (Raleigh, NC) www.Advancedenergy.org

Affordable Comfort Inc. (Waynesburg, PA) www.Aci.org

Alternative Energy www.altenergy.org/

American Council for an Energy-Efficient Economy (Washington, DC) www.aceeee.org

Architecture 2030 (Santa Fe, NM) info@architecture2030.org

Build it Green (Berkeley, CA) www.builditgreen.org

Building Knowledge Inc. (Minneapolis, MN) www.buildingknowledge.com

Building Performance Institute (BPI) (Malta, NY) www.bpi.org

Building Science Corporation (Somerville, MA) www.buildingscience.com

California Energy Commission (Sacramento, CA) www.wenergy.ca.gov

Energy Efficiency and Renewable Energy (EE/RE) Training Program Texas Workforce Commission Project

Canada Mortgage and Housing Corporation (Ottawa, Ont) www.omhc-schl.gc.ca/en

Energy and Environmental Building Alliance (Eden Prairie, MN) www.eeba.org

Energy Information Administration (Washington, DC) www.eia.doe.gov

Federal Emergency Management Agency (FEMA) (Washington, DC) www.fema.gov

Florida Solar Energy Center (Cocoa, FL) www.fsec.ucf.edu

Forest Stewardship Council (Minneapolis, MN) www.fscus.org

GreenBuilding.com (Boulder, CO) www.greenbuilding

International Code Council (Washington, DC) www.iccsafe.org

NAHB Research Center (Upper Marlboro, MD) www.Toolbase.org

National Association of Home Builders (Washington, DC) www.nahb.org

National Institute of Building Sciences (Washington, DC) www.nibs.org

National Renewable Energy Laboratory, (Golden, CO) www.nrel.gov

Net Zero Home Energy Home Coalition (Canada) www.netzeroenergyhome.ca

North American Association for Environmental Education (Washington, DC) www.naaee.org

Northeast Sustainable Energy Association (Greenfield, MA) www.nesea.org

Oak Ridge National Laboratory (Oak Ridge, TN) www.ornl.gov

Office of Scientific and Technical Information (Oak Ridge, TN) www.osti.gov

Passive House Institute (U.S.) (Urbana, IL) www.passivehouse.us

Structural Insulated Panel Association (Gig Harbor, WA) www.sipa.org

U.S. Department of Energy (Washington, DC) www1.eere.energy.gov

U.S. Green Building Council (Washington, DC) www.usgbc.org

U.S. Environmental Protection Agency (Washington, DC) www.epa.gov

CASE STUDY RESOURCES:

High Heat (Lakeland, FL) www.fsec.ucf.edu

Energy Efficiency and Renewable Energy (EE/RE) Training Program Texas Workforce Commission Project

A Butterfly Home in the City (Chicago, IL) www.dbhms.com, www.ggcinc.net

Outside-In Retrofit (Somerville, MA) www.byggmeister.com

PassivHaus Retrofit (Berkeley, CA) www.houseiseasystem.com

Bringing 1887 into the 21st Century (Santa Barbara, CA) www.dennisallenassociates.com

Target Zero House in Taos (Taos, NM) www.zeroEdesign.com

The Good Life in Vermont (Charlotte, VM) www.pillharam.com

The Next West House (Boulder, CO) www.hughesconstruct.com

High-End Lakeside Retrofit (Squam Lake, NH) www.garlandmill.com

A Solar Jewel in Boulder (Boulder, CO) www.morningstarbuilt.com

Reinventing the High Rise (New York City, NY) www.architectureandenergylimited.com

All-Electric House: \$1.16 a Day (Lenoir City, TN)

www1.eere.energy.gov/buildings/building_america, www.habitat.org

Affordable Housing Meets Zero Energy (Wheat Ridge, CO) www.nrel.gov, www.habitat.org

Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project

“EE/RE Technologies Certified Specialist – Carpentry” Course Outline

- Career Path in EE/RE for Carpenters
- Energy Efficiency (EE) Skills for Carpenters
- Energy and Related Systems and their components
 - Selection, Installation, Maintenance, and Repair
- Energy Efficiency Technologies Related to Carpentry Trade
- Energy Efficiency Equipment, Related Skills for Carpenters
- Building Science Related to EE for Carpenters
- Current IECC Intermediate
- Assessment Related to EE Required for Carpenters
- Renewable Energy (RE) Skills for Carpenters
- Renewable Energy Related Systems and Their Components
 - Solar Energy Systems Related to Carpentry
 - Wind Energy Systems Related to Carpentry
 - Geo-Thermal Systems Related to Carpentry
- Renewable Energy Technologies as Related to Carpentry Trade
- Building Science Related to RE for Carpenters
- Assessment Related to RE Required for Carpenters
- Carpenter as the Member of Building Trade Team
- Terms and Definitions for EE/RE Carpentry
- EE/RE Units of Instruction for EE/RE Technologies Related to Carpentry
- Selected Online References and Resources for EE/RE

Terms and Definitions for “EE/RE Technologies Certified Specialist – Carpentry”

List of Terms from and/or related to Carpentry Task List, Intermediate IECC Code, and Building Science related to Carpentry (expanded by instructor/trainer as needed).

Examples:

Air barriers: Materials that restrict the flow of air.

Vapor barriers: Materials that restrict the movement of water and humidity.

Fenestration: Building materials contain and/or made of glass (windows and doors).

Thermal barrier: A material applied over insulation, to slow the temperature rise of the foam during a fire so as to delay its involvement in the fire.

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Weatherproofing: The practice of protecting a building and its interior from the elements, particularly from sunlight, precipitation, and wind; modifying a building to reduce energy consumption and optimize energy efficiency.

Advanced framing: A structural system designed using conventional wood framing while reducing the total volume of lumber used.

Thermal envelope: Thermal insulation within the building enclosure.

Construction waste: Unwanted materials from a construction site.

Structural Insulated Panel System (SIPS): High performance building panels used in floors, walls, and roofs for residential and light commercial buildings. The panels are typically made by sandwiching a core of rigid foam plastic insulation between two structural skins of oriented strand board (OSB).

Units of Instruction for “EE/RE Technologies Certified Specialist – Carpentry”

Unit #	Unit of Instruction
1	The students will learn the proper installation technique of air/vapor barriers
2	The students will learn the proper installation technique for fenestration
3	The students will learn the proper installation technique for wall insulation
4	The students will learn the proper installation technique of thermal barriers
5	The students will learn the proper installation technique of weatherproofing/weather stripping (insulation)
6	The students will learn the proper installation technique of advanced framing with energy efficiency considerations
7	The students will learn the proper use of material management, and the reduction of construction waste
8	The students will learn the proper installation technique and the leak proofing of roof mounting equipment (RE equipment)

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9	The students will learn the proper selection of materials (EE/RE materials)
10	The students will learn the proper framing and spacing techniques of ceiling, walls, floors, foundations, based on advanced framing technology
11	The students will learn the proper cavity dimension continuity of skylight flashing, air sealing, and framing
12	The students will learn the proper protection of thermal envelope of the home
13	The students will learn the proper management of construction waste (waste reduction and recycling methods)
14	The students will learn the proper connection of panel jointing, protection of insulation and wiring in structural insulated panel systems (SIPS)
15	The students will learn the proper evacuation of bulk moisture and guttering of flashing valley
16	The students will learn the correct framing/structural support for RE systems (more important for existing retrofit projects)
17	The students will learn the proper structural support for PV and related systems (EE/RE systems)
18	The students will learn the proper rough opening sizing of windows and doors (advanced framing)
19	The students will learn the proper handling of foil back decking and nail sizing (radiant barriers)
20	The students will learn the proper installation procedure (EE/RE related systems for carpenters)
21	The students will learn the proper sizing of attic ventilation, if required
22	The students will learn the proper material management of framing layout
23	The students will learn the proper installation of exterior shading to ventilate structures, i.e. porches, overhangs
24	The students will learn proper materials protection
25	The students will learn the proper protection of dry materials from moisture damage

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26	The students will learn the proper coordinating activities among all trades
27	The students will learn daylight harvesting related to all buildings
28	The students will learn the importance of building envelope and its related systems in relation to each trade specialty
29	The students will learn the commissioning process
30	The students will learn design elements related to buildings
31	The students will learn the proper insulation for the building envelope
32	The students will learn the proper installation technique for all insulation
33	The students will learn the safety issues related to EE/RE for carpenters

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Building Performance Institute (BPI) (Malta, NY) www.bpi.org

Building Science Corporation (Somerville, MA) www.buildingscience.com

California Energy Commission (Sacramento, CA) www.wenergy.ca.gov

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Canada Mortgage and Housing Corporation (Ottawa, Ont) www.omhc-schl.gc.ca/en

Energy and Environmental Building Alliance (Eden Prairie, MN) www.eeba.org

Energy Information Administration (Washington, DC) www.eia.doe.gov

Federal Emergency Management Agency (FEMA) (Washington, DC) www.fema.gov

Florida Solar Energy Center (Cocoa, FL) www.fsec.ucf.edu

Forest Stewardship Council (Minneapolis, MN) www.fscus.org

GreenBuilding.com (Boulder, CO) www.greenbuilding

International Code Council (Washington, DC) www.iccsafe.org

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North American Association for Environmental Education (Washington, DC) www.naaee.org

Northeast Sustainable Energy Association (Greenfield, MA) www.nesea.org

Oak Ridge National Laboratory (Oak Ridge, TN) www.ornl.gov

Office of Scientific and Technical Information (Oak Ridge, TN) www.osti.gov

Passive House Institute (U.S.) (Urbana, IL) www.passivehouse.us

Structural Insulated Panel Association (Gig Harbor, WA) www.sipa.org

U.S. Department of Energy (Washington, DC) www1.eere.energy.gov

U.S. Green Building Council (Washington, DC) www.usgbc.org

U.S. Environmental Protection Agency (Washington, DC) www.epa.gov

CASE STUDY RESOURCES:

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High Heat (Lakeland, FL) www.fsec.ucf.edu

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Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project

“EE/RE Technologies Certified Specialist – Electrical” Course Outline

- Career Path in EE/RE for Electricians
- Energy Efficiency (EE) Skills for Electricians
- Energy and Related Systems and their components
 - Selection, Installation, Maintenance, and Repair
- Energy Efficiency Technologies Related to Electrician Trade
- Energy Efficiency Equipment, Related Skills for Electricians
- Building Science Related to EE for Electricians
- Current IECC Intermediate
- Assessment Related to EE Required for Electricians
- Renewable Energy (RE) Skills for Electricians
- Renewable Energy Related Systems and Their Components
 - Solar Energy Systems Related to Electricity
 - Wind Energy Systems Related to Electricity
 - Geo-Thermal Systems Related to Electricity
- Renewable Energy Technologies as Related to Electrician Trade
- Building Science Related to RE for Electricians
- Assessment Related to RE Required for Electricians
- Electrician as the Member of Building Trade Team
- Terms and Definitions for EE/RE Electrician
- Units of Instruction for EE/RE Technologies Related to Electrician
- Selected Online References and Resources for EE/RE

Terms and Definitions for “EE/RE Technologies Certified Specialist – Electrical”

List of Terms from and/or related to Electrician Task List, Intermediate IECC Code, and Building Science related to Electrical (expanded by instructor/trainer as needed).

Examples:

Wire sizing for PV: The size of the gauge (thickness) of wires used in PV application.

Power Factor: Balancing the electrical load.

Inverters: Devices that can tie the RE production to the grid and/or battery.

Smart building: A building, usually a new one that is equipped with special structured wiring to enable occupants to remotely control or program an array of automated home electronic devices by entering a single command.

Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project

Luminary: An object that gives light.

Thermal envelope: Thermal insulation within the building enclosure.

Vehicle charging stations: Designated areas containing external chargers for electric vehicles. Each station contains a plug that becomes attached to the vehicle, providing it with a current of electrical energy needed for propulsion.

Phantom load: Electric power consumed by electronic appliances while they are switched off or in a standby mode.

Units of Instruction for “EE/RE Technologies Certified Specialist – Electrical”

Unit #	Unit of Instruction
1	The students will learn proper wire sizing for RE systems
2	The students will learn to correct power factor (balancing the load) - (commercial)
3	The students will learn proper lighting power allowance
4	The students will learn the proper selection and installation of lighting controls
5	The students will learn to ensure proper grounding for EE/RE
6	The students will learn the proper selection and installation of occupant sensors
7	The students will learn the proper installation of home energy managing systems and other building types
8	The students will learn to trouble-shoot excessive consumption
9	The students will learn to Install and trouble shoot smart controls
10	The students will learn to calculate energy consumption of electrical loads

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11	The students will learn the proper selection of luminaries
12	The students will learn to select high-efficiency equipment (motors, transformers, etc.)
13	The students will learn to the proper protection of the thermal envelope of the home
14	The students will learn to Install remote lighting systems
15	The students will learn the methods of installation, repair, and maintenance of vehicle charging stations
16	The students will learn to Identify difference between grid tie and battery backup inverters
17	The students will learn the proper building automation and control systems
18	The students will learn to properly diagnose phantom load
19	The students will learn proper site evaluation for solar/wind systems
20	The students will learn the installation technique for wireless sensing and control of indoor environment for EE/RE
21	The students will learn the installation methods of under-floor wiring systems
22	The students will learn the proper sizing of light levels
23	The students will learn proper load management and reduction
24	The students will learn proper solar site survey process (pitch, azimuth, area)
25	The students will learn proper energy information monitoring and feedback systems and alerts
26	The students will learn to design, install, and trouble-shoot backup systems
27	The students will learn the proper coordinating activities among all trades

Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project

28	The students will learn daylight harvesting related to all buildings
29	The students will learn the importance of building envelope and its related systems in relation to each trade specialty
30	The students will learn the commissioning process
31	The students will learn design elements related to buildings
32	The students will learn the proper insulation for the building envelope
33	The students will learn the proper installation technique for all insulation
34	Students will learn the safety issues related to EE/RE for Electricians

Selected Online References and Resources for “EE/RE Technologies Certified Specialist – Electrical”

Advanced Energy (Raleigh, NC) www.Advancedenergy.org

Affordable Comfort Inc. (Waynesburg, PA) www.Aci.org

Alternative Energy www.altenergy.org/

American Council for an Energy-Efficient Economy (Washington, DC) www.aceeee.org

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California Energy Commission (Sacramento, CA) www.wenergy.ca.gov

Canada Mortgage and Housing Corporation (Ottawa, Ont) www.omhc-schl.gc.ca/en

Energy and Environmental Building Alliance (Eden Prairie, MN) www.eeba.org

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Energy Information Administration (Washington, DC) www.eia.doe.gov

Federal Emergency Management Agency (FEMA) (Washington, DC) www.fema.gov

Florida Solar Energy Center (Cocoa, FL) www.fsec.ucf.edu

Forest Stewardship Council (Minneapolis, MN) www.fscus.org

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National Institute of Building Sciences (Washington, DC) www.nibs.org

National Renewable Energy Laboratory (Golden, CO) www.nrel.gov

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Northeast Sustainable Energy Association (Greenfield, MA) www.nesea.org

Oak Ridge National Laboratory (Oak Ridge, TN) www.ornl.gov

Office of Scientific and Technical Information (Oak Ridge, TN) www.osti.gov

Passive House Institute (U.S.) (Urbana, IL) www.passivehouse.us

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U.S. Department of Energy (Washington, DC) www1.eere.energy.gov

U.S. Green Building Council (Washington, DC) www.usgbc.org

U.S. Environmental Protection Agency (Washington, DC) www.epa.gov

CASE STUDY RESOURCES:

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Bringing 1887 into the 21st Century (Santa Barbara, CA) www.dennisallenassociates.com

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The Next West House (Boulder, CO) www.hughesconstruct.com

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All-Electric House: \$1.16 a Day (Lenoir City, TN)
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- Current IECC Intermediate
- Assessment Related to EE Required for HVAC Technicians
- Renewable Energy (RE) Skills for HVAC Technicians
- Renewable Energy Related Systems and Their Components
 - Solar Energy Systems Related to HVAC
 - Wind Energy Systems Related to HVAC
 - Geo-Thermal Systems Related to HVAC
- Renewable Energy Technologies as Related to HVAC Trade
- Building Science Related to RE for HVAC Technicians
- Assessment Related to RE Required for HVAC Technicians
- HVAC Technician as the Member of Building Trade Team
- Terms and Definitions for EE/RE HVAC
- Units of Instruction for EE/RE Technologies Related to HVAC
- Selected Online References and Resources for EE/RE

Terms and Definitions for “EE/RE Technologies Certified Specialist – HVAC”

List of Terms from and/or related to HVAC Task List, Intermediate IECC Code, and Building Science related to HVAC Trade (expanded by instructor/trainer as needed).

Examples:

Manual J: Calculating the proper sizing of HVAC unit.

Airflow: Measurable amount of air moving within a duct

SEER: Seasonal Energy Efficiency Ratio.

Solar Heat Gain Coefficient (SHGC): The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation.

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Air balancing: A process of measuring and adjusting air flow to the needs of the occupants.

Thermal envelope: Thermal insulation within the building enclosure.

Blower door test: A diagnostic tool designed to measure the air tightness of buildings and to help locate air leakage sites.

Hydronics: The use of water as the heat-transfer medium in heating and cooling systems. Some of the oldest and most common examples are steam and hot-water radiators.

Mechanical chase: A hollow section of wall (or floor or ceiling) thru which mechanical ductwork or other building systems are run.

ACCA: Air Conditioning Contractors of America.

Units of Instruction for “EE/RE Technologies Certified Specialist – HVAC”

Unit #	Unit of Instruction
1	The students will learn the proper installation of HVAC ducts
2	The students will learn to Calculate manual J (proper sizing of HVAC)
3	The students will learn the proper sizing and selection of equipment
4	The students will learn to select the high efficiency options for residential and commercial HVAC systems
5	The students will learn the proper installation of ducts - size, field modifications, restrictions, ease of airflow
6	The students will learn to measure airflow
7	The students will learn to perform the commissioning of advanced control systems
8	The students will learn the proper location of thermostats

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Texas Workforce Commission Project

9	The students will learn to calculate internal heat loads for equipment sizing
10	The students will learn the proper methods of installation of equipment
11	The students will learn the methods of Installation, maintenance, and repair of comfort and ventilation systems
12	The students will learn how to locate HVAC equipment properly
13	The students will learn to determine fresh air ventilation requirements properly
14	The students will learn to do air balancing/pressure diagnostic, layout
15	The students will learn proper duct sealing methods, duct to machinery, and duct to duct
16	The students will learn the proper installation of mechanical systems under floor (residential) and raised floor (commercial)
17	The students will learn to test for combustion safety
18	The students will learn to assess system performance
19	The students will learn to calculate heat loss and gain
20	The students will learn the proper location of recessed cans/HVAC registers
21	The students will learn the proper selection of high-efficiency variable speed pumps, motors, fans, etc.
22	The students will learn to maximize airflow and minimize air restrictions
23	The students will learn the proper location of air intakes and outtakes
24	The students will learn the proper ventilation of attics.
25	The students will learn the proper protection of the thermal envelope of the home

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26	The students will learn the proper selection of filtration systems for air pollution
27	The students will learn to conduct blower door test
28	The students will learn the proper installation of drains--traps and venting
29	The students will learn proper system decommissioning and disposal
30	The students will learn the proper operation of duct blower/tester
31	The students will learn the proper sizing of openings/blocking
32	The students will learn to optimize performance via design
33	The students will learn the methods of installation, repair, and maintenance for Hydronic pressure, temps, flow path, field norms, pump cir service
34	The students will learn the proper methods of installation of under-floor air distribution
35	The students will learn the proper sizing of mechanical chasing
36	The students will learn to calculate heat transfer
37	The students will learn the proper method of installation, maintenance, and repair of evaporated ammonia cooling systems
38	The students will learn to ensure quality installation practice (ACCA source)
39	The students will learn the proper coordinating activities among all trades
40	The students will learn daylight harvesting related to all buildings
41	The students will learn the importance of building envelope and its related systems in relation to each trade specialty
42	The students will learn the commissioning process

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43	The students will learn design elements related to buildings
44	The students will learn the roles of Energy Rater and Building Science Consultant who determine EE rating and materials
45	The students will learn the importance of register placement and shorter duct systems
46	The students will learn the ASHRAE design guidelines for building locale
47	The students will learn the minimum efficiency ratings for HVAC equipment as required by IECC and ASHRAE 90.5
48	The students will learn technologies related to HVAC controls and Building Automation Systems (BAS)
49	The students will learn the outside air requirements of ASHRAE 62.1
50	The students will learn the controls required and the operation of HVAC systems during occupied and non-occupied times
51	Students will learn the safety issues related to EE/RE for HVAC technicians

Selected Online References and Resources for “EE/RE Technologies Certified Specialist – HVAC”

Advanced Energy (Raleigh, NC) www.Advancedenergy.org

Affordable Comfort Inc. (Waynesburg, PA) www.Aci.org

Alternative Energy www.altenergy.org/

American Council for an Energy-Efficient Economy (Washington, DC) www.aceeee.org

Architecture 2030 (Santa Fe, NM) info@architecture2030.org

Build it Green (Berkeley, CA) www.builditgreen.org

Building Knowledge Inc. (Minneapolis, MN) www.buildingknowledge.com

Building Performance Institute (BPI) (Malta, NY) www.bpi.org

Building Science Corporation (Somerville, MA) www.buildingscience.com

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California Energy Commission (Sacramento, CA) www.wenergy.ca.gov

Canada Mortgage and Housing Corporation (Ottawa, Ont) www.omhc-schl.gc.ca/en

Energy and Environmental Building Alliance (Eden Prairie, MN) www.eeba.org

Energy Information Administration (Washington, DC) www.eia.doe.gov

Federal Emergency Management Agency (FEMA) (Washington, DC) www.fema.gov

Florida Solar Energy Center (Cocoa, FL) www.fsec.ucf.edu

Forest Stewardship Council (Minneapolis, MN) www.fscus.org

GreenBuilding.com (Boulder, CO) www.greenbuilding

International Code Council (Washington, DC) www.iccsafe.org

NAHB Research Center (Upper Marlboro, MD) www.Toolbase.org

National Association of Home Builders (Washington, DC) www.nahb.org

National Institute of Building Sciences (Washington, DC) www.nibs.org

National Renewable Energy Laboratory (Golden, CO) www.nrel.gov

Net Zero Home Energy Home Coalition (Canada) www.netzeroenergyhome.ca

North American Association for Environmental Education (Washington, DC) www.naaee.org

Northeast Sustainable Energy Association (Greenfield, MA) www.nesea.org

Oak Ridge National Laboratory (Oak Ridge, TN) www.ornl.gov

Office of Scientific and Technical Information (Oak Ridge, TN) www.osti.gov

Passive House Institute (U.S.) (Urbana, IL) www.passivehouse.us

Structural Insulated Panel Association (Gig Harbor, WA) www.sipa.org

U.S. Department of Energy (Washington, DC) www1.eere.energy.gov

U.S. Green Building Council (Washington, DC) www.usgbc.org

U.S. Environmental Protection Agency (Washington, DC) www.epa.gov

CASE STUDY RESOURCES:

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High Heat (Lakeland, FL) www.fsec.ucf.edu

A Butterfly Home in the City (Chicago, IL) www.dbhms.com, www.ggcinc.net

Outside-In Retrofit (Somerville, MA) www.byggmeister.com

PassivHaus Retrofit (Berkeley, CA) www.houseiseasystem.com

Bringing 1887 into the 21st Century (Santa Barbara, CA) www.dennisallenassociates.com

Target Zero House in Taos (Taos, NM) www.zeroEdesign.com

The Good Life in Vermont (Charlotte, VM) www.pillharam.com

The Next West House (Boulder, CO) www.hughesconstruct.com

High-End Lakeside Retrofit (Squam Lake, NH) www.garlandmill.com

A Solar Jewel in Boulder (Boulder, CO) www.morningstarbuilt.com

Reinventing the High Rise (New York City, NY) www.architectureandenergylimited.com

All-Electric House: \$1.16 a Day (Lenoir City, TN)

www1.eere.energy.gov/buildings/building_america, www.habitat.org

Affordable Housing Meets Zero Energy (Wheat Ridge, CO) www.nrel.gov, www.habitat.org

Energy Efficiency and Renewable Energy (EE/RE) Training Program
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“EE/RE Technologies Certified Specialist – Plumbing” Course Outline

- Career Path in EE/RE for Plumbers
- Energy Efficiency (EE) Skills for Plumbers
- Energy and Related Systems and their components
 - Selection, Installation, Maintenance, and Repair
- Energy Efficiency Technologies Related to Plumber Trade
- Energy Efficiency Equipment, Related Skills for Plumbers
- Building Science Related to EE for Plumbers
- Current IECC Intermediate
- Assessment Related to EE Required for Plumbers
- Renewable Energy (RE) Skills for Plumbers
- Renewable Energy Related Systems and Their Components
 - Solar Energy Systems Related to Plumbing
 - Wind Energy Systems Related to Plumbing
 - Geo-Thermal Systems Related to Plumbing
- Renewable Energy Technologies as Related to Plumber Trade
- Building Science Related to RE for Plumbers
- Assessment Related to RE Required for Plumbers
- Plumber as the Member of Building Trade Team
- Terms and Definitions for EE/RE Plumbing
- Units of Instruction for EE/RE Technologies Related to Plumbing
- Selected Online References and Resources for EE/RE

Terms and Definitions for “EE/RE Technologies Certified Specialist – Plumbing”

List of Terms from and/or related to Plumber Task List, Intermediate IECC Code, and Building Science related to Plumbing (expanded by instructor/trainer as needed).

Examples:

On-demand water heater: Water heater that functions only when water is flowing through it

Thermal envelope: The construction of a building that is in contact with the outside

Rainwater harvesting: Methods and systems by which the rainwater is captured, stored, and used for water conservation.

Irrigation: An artificial application of water to the soil.

Energy Efficiency and Renewable Energy (EE/RE) Training Program
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PEX: Cross-linked polyethylene. It is formed into tubing, and is used predominantly in hydronic radiant heating systems, domestic water piping, and insulation for high tension (high voltage) electrical cables.

Units of Instruction for “EE/RE Technologies Certified Specialist – Plumbing”

Unit #	Unit of Instruction
1	The students will learn how to locate and install on-demand water heating systems
2	The students will learn the proper installation of black/grey water systems
3	The students will learn the proper sizing of pipes for all EE/RE related systems
4	The students will learn the distribution of hot water systems
5	The students will learn the methods of harvesting rainwater
6	The students will learn to Identify opportunities for water efficiency
7	The students will learn the proper selection of piping materials for EE/RE systems
8	The students will learn the proper design, installation, and evaluation of circulating water systems
9	The students will learn the proper installation of solar/thermal systems (hot water)
10	The students will learn to calculate pressure and flow rates
11	The students will learn the proper protection of thermal envelope of the buildings
12	The students will learn to select efficient irrigation systems
13	The students will learn to Install PEX (w/ central manifold) vs. standard PVC system

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14	The students will learn to follow proper manufacturer installation requirements
15	The students will learn the proper installation, repair, and maintenance of hot water assist system piping
16	The students will learn the proper installation, repair, and maintenance of radiant heating systems
17	The students will learn the proper installation of integrated heat systems
18	The students will learn the proper selection of fixtures as related to EE/RE
19	The students will learn to calculate fixture units
20	The students will learn to install storm water collection and systems
21	Students will learn all aspects of communication and seeking guidance from other professionals
22	The students will learn the proper coordinating activities among all trades
23	The students will learn the importance of building envelope and its related systems in relation to each trade specialty
24	The students will learn the commissioning process
25	The students will learn design elements related to buildings
26	Students will learn the safety issues related to EE/RE for Plumbers

Selected Online References and Resources for “EE/RE Technologies Certified Specialist – Plumbing”

Advanced Energy (Raleigh, NC) www.Advancedenergy.org

Affordable Comfort Inc. (Waynesburg, PA) www.Aci.org

Alternative Energy www.altenergy.org/

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Architecture 2030 (Santa Fe, NM) info@architecture2030.org

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Building Knowledge Inc. (Minneapolis, MN) www.buildingknowledge.com

Building Performance Institute (BPI) (Malta, NY) www.bpi.org

Building Science Corporation (Somerville, MA) www.buildingscience.com

California Energy Commission (Sacramento, CA) www.wenergy.ca.gov

Canada Mortgage and Housing Corporation (Ottawa, Ont) www.omhc-schl.gc.ca/en

Energy and Environmental Building Alliance (Eden Prairie, MN) www.eeba.org

Energy Information Administration (Washington, DC) www.eia.doe.gov

Federal Emergency Management Agency (FEMA) (Washington, DC) www.fema.gov

Florida Solar Energy Center (Cocoa, FL) www.fsec.ucf.edu

Forest Stewardship Council (Minneapolis, MN) www.fscus.org

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North American Association for Environmental Education (Washington, DC) www.naaee.org

Northeast Sustainable Energy Association (Greenfield, MA) www.nesea.org

Oak Ridge National Laboratory (Oak Ridge, TN) www.ornl.gov

Office of Scientific and Technical Information (Oak Ridge, TN) www.osti.gov

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Passive House Institute (U.S.) (Urbana, IL) www.passivehouse.us

Structural Insulated Panel Association (Gig Harbor, WA) www.sipa.org

U.S. Department of Energy (Washington, DC) www1.eere.energy.gov

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U.S. Environmental Protection Agency (Washington, DC) www.epa.gov

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Outside-In Retrofit (Somerville, MA) www.byggmeister.com

PassivHaus Retrofit (Berkeley, CA) www.houseiseasystem.com

Bringing 1887 into the 21st Century (Santa Barbara, CA) www.dennisallenassociates.com

Target Zero House in Taos (Taos, NM) www.zeroEdesign.com

The Good Life in Vermont (Charlotte, VM) www.pillharam.com

The Next West House (Boulder, CO) www.hughesconstruct.com

High-End Lakeside Retrofit (Squam Lake, NH) www.garlandmill.com

A Solar Jewel in Boulder (Boulder, CO) www.morningstarbuilt.com

Reinventing the High Rise (New York City, NY) www.architectureandenergylimited.com

All-Electric House: \$1.16 a Day (Lenoir City, TN)

www1.eere.energy.gov/buildings/building_america, www.habitat.org

Affordable Housing Meets Zero Energy (Wheat Ridge, CO) www.nrel.gov, www.habitat.org

Appendix A

Task Lists Associated with the Proposed Curricula
Energy Efficiency/Renewable Energy (EE/RE) Training
Task Lists

CONTENT

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Energy Efficiency and Renewable Energy (EE/RE) Training Program Texas Workforce Commission Project

Introduction

The Energy Systems laboratory (ESL) at the Texas Engineering Experiment Station (TEES) of the Texas A&M University is the recipient of a grant to develop and implement a training program related to Energy Efficiency/Renewable Energy, and the 2009 International Energy Conservation Codes (IECC).

This project is funded by the Workforce Investment Act (WIA) and the American Recovery and Reinvestment Act of 2009 (ARRA) through the Texas Workforce Commission.

An important aspect of this project was the development of training curricula for entry level workers, such as building trades apprentices, and for incumbent technicians in the fields of Carpentry, Electrical, HVAC and Plumbing. The training curricula would provide the foundation to the much needed Technical Skills Training (TST) programs. The goals of this project are to improve the workforce competencies in meeting the Texas Building Energy Performance Standards and the requirements of the EE/RE Industries.

The curricula should be available through Texas Higher Education Coordinating Board to interested Community Colleges and Technical Institutes. These institutions would be able to adopt and offer the recommended courses and upon successful completion issue a "Certificate Endorsement in EE/RE" to their students/trainees.

The development of the training curricula was based on five task lists related to EE/RE and IECC. The methodology for this development was based on the published research (For further information and citations: Bastani, 1999, Texas A&M University, College Station, Texas). Per definition: Task List (Task Inventory): is a list of the various tasks that require Mastery Level of **performance** for an individual to satisfy the requirements of a job. The task lists in this project indicate the much needed competencies in the fields of EE/RE for our workforce.

This document outlines the task lists for the four building trades -- Carpentry, Electrical, HVAC and Plumbing, plus an additional general task list for entry level workers in all four trades. In each task list, the tasks are ordered according to their identified level of importance, with 1 being the most important task. In addition, each task is associated with a percentage of importance that was calculated based on the numerical value SMEs assigned to them. Those numbers were converted to equivalent percentage values.

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In addition, the document contains recommendations on how to properly use the task lists in Technical Skills Training (TST) programs (the section on **Credentialing On-The-Job Training** in this document).

Acknowledgements

The Task Lists Development included a detailed process involving identification of tasks, development of task lists and verification of those lists, and was the end result of the direct and indirect participation and contribution of many individuals. This process included long session meetings with Subject Matter Experts (SMEs) from the industry and the educational sector. The methodology for this development was based on the published research (For further information and citations: Bastani, 1999, Texas A&M University, College Station, Texas).

This part of the project was led by the International Polytechnic Institute, Inc., president, Dr. Fred Bastani, and staff. The ESL contributed with overall facilitation and coordination of the process and with participation of a Subject matter Expert in the meetings. The Good Company Associates, Inc. identified SMEs, and coordinated and hosted meetings for Phase I - the Task Lists Development. The College of Architecture at Texas A&M University identified SMEs, and coordinated and hosted a meeting for Phase II - the Task Lists Validation Process, the College of Architecture also provided professors, knowledgeable in EE/RE, who participated in the meetings. The Texas Home Rating Organization (TX HERO) provided a SME who participated in Phase I meetings.

The most important acknowledgements and our gratitude are to the SMEs who gave their time and effort for the successful completion of the **Task Lists**. The followings are the list of SMEs who were members of these panels.

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Energy Efficiency and Renewable Energy (EE/RE) Training Program
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Phase II Subject Matter Experts (SMEs)

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John Cody
W.M. Dillard & Associates
Houston, Texas

Phil Crowne
Dallas Builders
Dallas, Texas

Mike Dishberger
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Clayton Farmer
Ontility + Energy Services
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Texas Association of Builders
Austin, Texas

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AEP Texas/Habitat For Humanity
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Performance-Based Training

As the term implies, Performance-Based training is synonymous with competency-based training. The outcome of this training is the **ability** of the trainee or the student to perform the technical skill or the task of the job properly. Therefore, the most effective skill development activity, as well as on-the-job training should use a systemic approach. Such system has Input, Process, Output, and Evaluation components.

The credentialing process for technicians should have the above components.

Credentialing On-The-Job Training (Performance-Based)

The following model is based on research on adult learning principles. It is recommended for use with the tasks identified in this document.

The Input include: Task, Trainee, Trainer

The Process includes: Seven Step Model

Output includes: Mastery level of performance of the task

Evaluation: During the process and of the outcome

The seven step model as the core component of this activity requires a Trainer who has already demonstrated the mastery level performance of the task. The seven steps are as follows:

Trainer

1. Identifies The Task
2. Explains What To Do
3. Demonstrates How To Do It
4. Lets The Trainee Practice
5. Critiques The Practice

Trainee

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6. Repeats Steps 4 & 5 As Often As Necessary

7. Explains While Performing The Task

In formal and structured training programs (such as apprenticeship, on-the-job training, or certification) it is recommended that documentation show the date the task was introduced and demonstrated, the date(s) the trainee had opportunity to practice (the length of the practice period), and the date the trainee got checked off on the particular task. Such documentation is essential for credentialing process.

Energy Efficiency/Renewable (EE/RE) Energy Task Lists

EE/RE Basic Task List

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Task #	EE/RE BASIC TASKS	Importance Value in %
1	Be familiar with proper protection of thermal envelope of the home (all trades)	82
2	Be familiar with overview of building systems	79
3	Be familiar with management of construction waste (waste reduction and recycling methods)	77
4	Be familiar with site safety	75
5	Be familiar with proper use of material management; reduce construction waste	73
6	Be familiar with communication and seek guidance from other professionals	73
7	Be familiar with Proper education of consumers (all trades)	73
8	Be familiar with coordination amongst trades (general)	72
9	Be familiar with productivity vs. quality concepts (increasing knowledge)	70
10	Be familiar with priority of tasks and installation sequence among trades	69
11	Be familiar with proper selection of materials	65
12	Be familiar with environmental protection	64
13	Hold team meeting for beginners before starting a job (all trades)	63
14	Be familiar with energy efficient and advanced framing	62
15	Be familiar with proper installation procedures for all systems	60
16	Be familiar with proper installation of thermal barrier	60

EE/RE Carpenter Task List

**Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project**

Task #	EE/RE CARPENTER TASKS	Importance Value in %
1	Properly install air/vapor barriers	92
2	Properly install fenestration	89
4	Properly install wall insulation	88
5	Properly install thermal barrier	88
7	Proper weather-proofing/weather-stripping (insulation)	86
8	Proper advanced framing with energy efficiency considerations	84
9	Proper use of material management; reduce construction waste	81
11	Properly install and leak proof roof mounting equipment	80
12	Properly select materials	76
13	Proper framing and spacing of ceiling, walls, floors, and foundations	75
14	Proper cavity dimension continuity of skylight flashing, air sealing, and framing	73
15	Properly protect thermal envelope of the home (all trades)	73
16	Properly manage construction waste (waste reduction and recycling methods)	71
17	Proper connection of panel jointing, protection of insulation and wiring in structural insulated panel systems (SIPS)	71
19	Proper evacuation of bulk moisture and guttering of flashing valley	71
21	Ensure correct framing/structural support for RE systems (more important for existing)	70
22	Ensure proper structural support for PV and related systems (EE/RE systems)	70
23	Proper rough opening sizing of windows and doors	70
24	Proper handling of foil back decking and nail sizing	68
25	Properly follow installation procedure	67
26	Proper sizing of attic ventilation	67
28	Proper material management of framing layout	66
29	Proper installation of exterior shading to ventilate structures, i.e. porches	63
30	Proper materials protection	62
31	Protect dry materials from moisture damage	61

EE/RE Plumber Task List

**Energy Efficiency and Renewable Energy (EE/RE) Training Program
Texas Workforce Commission Project**

Task #	EE/RE PLUMBER TASKS	Importance Value in %
1	Locate and install on-demand water heating	87
3	Proper installation of black/grey water systems	86
4	Proper pipe sizing	85
5	Hot water distribution	84
6	Properly harvest rainwater	84
7	Identify opportunities for water efficiency	83
8	Proper piping materials	82
9	Proper design, installation, and evaluation of circulating water systems	80
10	Properly install solar/thermal systems (hot water)	79
11	Calculate pressure and flow rates	73
12	Properly protect thermal envelope of the home (all trades)	70
13	Select efficient irrigation systems	70
14	Installation of PEX (w/ central manifold) vs. standard PVC system	69
15	Follow proper manufacturer installation requirements	68
17	Properly install, repair, and maintain hot water assist system piping	65
18	Properly install, repair, and maintain radiant heating systems	64
19	Properly install integrated heat systems	64
20	Proper selection of fixtures	63
21	Ability to calculate fixture units	61
22	Storm water collection and system installation	61
24	Communicate and seek guidance from other professionals	61
26	Coordinate amongst trades (general)	60

EE/RE Electrician Task List

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Texas Workforce Commission Project

Task #	EE/RE ELECTRICIAN TASKS	Importance Value in %
2	Proper wire sizing for RE systems	84
4	Ability to correct power factor (balancing the load) - (commercial)	83
7	Proper lighting power allowance	82
8	Proper lighting control selection and installation	82
9	Ensure proper grounding for EE/RE	82
12	Properly select and install occupant sensors	80
13	Properly install home energy managing systems and other building types	80
14	Trouble-shooting excessive consumption	80
15	Install and trouble shoot smart controls	78
16	Calculate energy consumption of electrical loads	78
20	Properly select luminaries	76
21	Select high-efficiency equipment (motors, transformers, etc.)	73
23	Properly protect thermal envelope of the home (all trades)	71
24	Installation of remote lighting systems	71
25	Ability to install, repair, and maintain vehicle charging stations	70
26	Identify difference between grid tie and battery backup inverters	70
27	Proper building automation and control systems	69
28	Properly diagnose phantom load	68
29	Proper site evaluation for solar/wind systems	67
30	Install wireless sensing and control of indoor environment for EE/RE	67
31	Install under-floor wiring systems	67
32	Proper sizing of light levels	66
33	Proper load management and reduction	66
34	Proper solar site survey process (pitch, azimuth, area)	64
35	Proper energy information monitoring and feedback systems and alerts	64
36	Design, install, and trouble-shoot backup systems	62

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EE/RE HVAC Task List

Task #	EE/RE HVAC TASKS	Importance Value in %
1	Properly install HVAC duct	96
2	Calculate manual J (proper sizing of HVAC)	94
4	Proper equipment sizing and selection	92
6	Selection of high efficiency options for residential and commercial HVAC systems	90
7	Proper duct installation - size, field modifications, restrictions, ease of airflow	89
9	Measure airflow	88
13	Ability to perform commissioning of advanced control systems	88
15	Properly locate thermostat	88
16	Proper calculation of internal heat loads for equipment sizing	87
17	Properly install equipment	87
18	Installing, maintaining, and repairing comfort and ventilation system	87
19	Proper location of HVAC equipment	86
20	Properly determine fresh air ventilation requirements	86
21	Ability to do air balancing/pressure diagnostic, layout	85
24	Proper duct sealing method, duct to machinery, duct to duct	84
25	Properly install mechanical systems under floor (residential) and raised floor (commercial)	82
26	Test for combustion safety	80
27	Assess system performance	79
28	Calculate heat loss and gain	78
29	Properly locate recessed cans/HVAC registers	78
30	Properly select high-efficiency variable speed pumps, motors, fans, etc.	78
31	Maximize airflow and minimize air restrictions	77
32	Properly locate air intake and outtake	76
33	Proper attic ventilation	75
34	Properly protect thermal envelope of the home (all trades)	74
35	Proper selection of filtration systems for air pollution	74
37	Conduct blower door test	73
39	Proper drain installation - traps and venting	73
40	Proper system decommissioning and disposal	72
41	Properly operate duct blower/tester	70
42	Properly size openings/blocking	70
43	Optimize performance via design	68
44	Ability to install, repair, and maintain Hydronic pressure, temps, flow path, field norms, pump cir service	68

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45	Properly install under-floor air distribution	68
47	Proper sizing of mechanical chasing	67
48	Calculate heat transfer	65
49	Proper installation, maintenance, and repair of evaporated ammonia cooling systems	62
50	Ensure quality installation practice (ACCA source)	61